

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

Draft Implementation Framework
Report for the Control of Diazinon and
Chlorpyrifos in the San Joaquin River
Basin



September 2002

State of California
California Environmental Protection Agency
REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

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List of Acronyms and Abbreviations

§	Section (as in a law or regulation)
§§	Sections (as in a law or regulation, plural)
a.i.	Active ingredient of a pesticide
art.	Article (as in a law or regulation)
Basin Plan	Water Quality Control Plan (Basin Plan) Central Valley Region ; Sacramento River and San Joaquin River Basins
<i>Bt</i>	<i>Bacillus thuringiensis</i>
CAC	County Agricultural Commissioners
Cal. Code Regs.	California Code of Regulations
Cal. Const.	California Constitution
Cal EPA	California Environmental Protection Agency
CDFA	California Department of Food and Agriculture
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
C.F.R.	Code of Federal Regulations
ch.	Chapter (as in a law or regulation)
commissioner	In the discussion in section 2.2.2 refers to the county agricultural commissioner
CVRWQCB	California Regional Water Quality Control Board, Central Valley Region
CWA	Federal Clean Water Act
department	In the discussion in section 2.2.2 refers to the Department of Pesticide Regulation
DFA	California Department of Food and Agriculture
director	In the discussion in section 2.2.2 refers to the director of the Department of Pesticide Regulation
div.	Division (as in a law or regulation)
DO	Dormant oil
DPR	California Department of Pesticide Regulation
DWR	California Department of Water Resources
ELISA	Enzyme-linked immunosorbent assays
et seq.	“and following” (references a series of related sections of law)
FAC, Food & Agr. Code	California Food and Agricultural Code
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
Ibid.	“ibidem” (same citation or reference as the immediately preceding citation or reference)
IPM	Integrated Pest Management
JPA	Joint Exercise of Powers Authority
OEHHA	Office of Environmental Health Hazard Assessment
Ops. Cal. Atty. Gen.	Opinions of the California Attorney General
NHI	Natural Heritage Institute
No.	number
NPDES	National Pollutant Discharge Elimination System
NPS	Non-point Source
NRCS	Natural Resources Conservation Service
OP	Organo-phosphorus or Organo-phosphorus Pesticide
p./ pp.	Page/ pages
PCO	Pest control operator

§	Section (as in a law or regulation)
pers. comm.	personal communication (either written or oral)
Plums	Refers to both dried and fresh fruit
Porter-Cologne or Porter-Cologne Act	Porter-Cologne Water Quality Control Act as amended
PRMP	Pesticide Runoff Minimization Plan
PTB	Peach twig borer
Pub. Resources Code	California Public Resources Code
Regional Board	California Regional Water Quality Control Board, Central Valley Region or, if smaller case, refers to the Regional Boards in general
ROWD	Report of Waste Discharge
RUP	Restricted use pesticide
RWQCB	Regional Water Quality Control Board
SJS	San Jose scale
SLDMWA	San Luis & Delta-Mendota Water Authority
SLN	Special Local Needs
State Board or SWRCB	California State Water Resources Control Board
subd.	Subdivision (as in a law or regulation)
tit.	Title (as in a law or regulation)
TMDL	Total Maximum Daily Load
UCIPM	University of California Statewide Integrated Pest Management Project
USBR	United States Bureau of Reclamation
U.S.C.	United States Code
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
Water Code or Wat. Code	California Water Code
WDRs	Waste Discharge Requirements

1 Introduction

1.1 Purpose

The purpose of this report is to describe a number of alternative approaches that could be applied to control the runoff of diazinon and chlorpyrifos to the San Joaquin River. This report describes the alternative management strategies and alternative frameworks for implementation. In addition, alternative approaches for monitoring and surveillance of attainment of water quality objectives and implementation of management practices are described in this document.

This report provides the background information and framework needed by Regional Board staff to develop a recommended program of implementation. The recommended program of implementation will be included in a draft Basin Plan Amendment staff report to be released in Spring 2003.

This report is modeled after the report developed for the draft program of implementation for control of diazinon in the Sacramento and Feather Rivers (Karkoski et.al, 2002). The first two sections of this report are included almost verbatim from Karkoski et. al. Sections 3 and 4 are modified to reflect:

1. Practices needed for control of not just diazinon, but also of chlorpyrifos.
2. Use of diazinon and chlorpyrifos in the San Joaquin basin occurs in not just the dormant season, but also during the irrigation season.
3. Geographic differences that exist between the Sacramento and San Joaquin watersheds.

Much of the information in Section 3 was taken from the Agricultural Practices and Technologies draft report (Reyes et.al, 2002). The information on conservation buffers, including photographs, in Section 3 was taken primarily from the Natural Resources Conservation Service (NRCS) report, *Conservation Buffers to Reduce Pesticide Losses*. March 2000.

1.2 Regulatory Background

Section 303(d) of the federal Clean Water Act (CWA) requires the development of Total Maximum Daily Loads (TMDLs) for those waters that are identified as not attaining water quality standards, even after full implementation of technological controls. The TMDLs must be incorporated into the State's water quality management plan. State law (Porter-Cologne Water Quality Control Act) requires that any new water quality objectives developed as part of a TMDL also be incorporated into the appropriate water quality management plan, along with a program of implementation.

The process for incorporation of TMDLs (and other regulatory provisions) into the State's water quality management plan is defined in the California Water Code (Wat. Code, § 13240 et seq.) The TMDLs for the Central Valley Region will be incorporated into the Water Quality Control Plan for the San Joaquin and Sacramento River Basins or the Water Quality Control Plan for the Tulare Lake Basin, depending on the location of the affected waters (the Water Quality Control Plans are generally referred to as "Basin Plans").

In addition to the federal requirements to incorporate TMDLs into the appropriate Basin Plan, the California Water Code requires that a program of implementation be identified which, at a minimum, includes: “...(a) A description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private. (b) A time schedule for actions to be taken. (c) A description of surveillance to be undertaken to determine compliance with objectives.” (Wat. Code, § 13242.)

The California Environmental Quality Act (CEQA) requires the Regional Board to conduct an environmental analysis of the reasonably foreseeable methods of compliance (Pub. Resources Code, § 21159; Cal. Code Regs., tit. 14, § 15064) and to take into account a reasonable range of environmental, economic, and technical factors. The Regional Board must also consider reasonable alternatives to any proposed amendment to the Basin Plan. (Cal. Code Regs., tit. 23, § 3777.)

1.3 Assumptions

For purposes of this report the following assumptions are made:

- 1) Numeric water quality objectives for diazinon and chlorpyrifos in the San Joaquin River Basin will be adopted by the Regional Board concurrently with a program of implementation and TMDL.
- 2) The Regional Board will establish load limits for diazinon and chlorpyrifos in the San Joaquin River as described in the *Draft San Joaquin River Diazinon and Chlorpyrifos Total Maximum Daily Load Report*, July 2002..
- 3) Compliance will be monitored at a minimum in the San Joaquin River, but may also include evaluation of changes in tributary loads, changes in implementation of management measures, and other factors.
- 4) The adopted Basin Plan cannot compel adoption of specific diazinon and chlorpyrifos runoff mitigation practices, nor can it compel specific action by agencies such as the Department of Pesticide Regulation or the County Agricultural Commissioners, who have authority to regulate pesticide use.
- 5) An entity other than the Regional Board can design and implement a program that will result in the changes necessary to attain water quality objectives. The Regional Board would need to approve of such a program and track the success of the program in attaining interim goals, performance standards, and water quality objectives.
- 6) Urban contributions of diazinon and chlorpyrifos to the lower San Joaquin River will be negligible due to their already limited urban use, along with the phase out of residential uses of these pesticides. Retail sales of chlorpyrifos for residential use ended on December 31, 2001, and legal use by licensed applicators for termite control will end on December, 2005. Residential use of diazinon is also being phased out, with sales for all indoor uses ending December 31, 2002, and sales for outdoor uses ending December 31, 2004.

These assumptions are made to allow Regional Board staff to conduct a baseline analysis for this report. The assumptions may change as a result of input from the public, peer reviewers, and the Regional Board.

2 Implementation Framework

2.1 Introduction

The implementation framework will describe how the Regional Board plans to ensure compliance with adopted water quality objectives and TMDLs for diazinon and chlorpyrifos in the San Joaquin River. The implementation framework will result from an evaluation of who can provide objective oversight and assurance of compliance, and who will be responsible for ensuring that the necessary changes in management practices are made.

Ultimately, the Regional Board is responsible for protecting water quality and can not delegate that responsibility. An alternative framework that does not involve direct Regional Board oversight would still require the Regional Board to evaluate progress in attaining interim milestones, performance goals, and the water quality objectives.

2.2 Legal Authorities

This section describes the legal authorities available to those who affect the discharge into waters of the state. The primary entities that do or could have authority over pesticide use or pesticides in surface water are described.

2.2.1 Regional Water Quality Control Board

This section describes the Regional Board's authorities under Porter-Cologne and the Federal Clean Water Act to regulate discharges of pesticides (and other contaminants) to waters of the state.

Porter-Cologne Water Quality Control Act

Division 7 of the California Water Code (Water Code), known as the Porter-Cologne Water Quality Control Act (Porter-Cologne Act), is the principal law governing water quality regulation in California. Enacted in 1969, it establishes a comprehensive program to protect water quality and the beneficial uses of water. The Porter-Cologne Act applies to surface waters, wetlands, and ground water and to both point and nonpoint sources of pollution. Water Code section 13000 provides:

- that the quality of all the waters of the state shall be protected for use and enjoyment by the people of the state;
- that activities and factors which may affect the quality of the waters of the state shall be regulated to attain the highest water quality which is reasonable, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible; and
- that the State must be prepared to exercise its full power and jurisdiction to protect the quality of the waters in the State from degradation.

The Porter-Cologne Act established the State Water Resources Control Board (SWRCB) and the nine Regional Water Quality Control Boards (RWQCBs) which are charged with implementing its provisions and have primary responsibility for protecting water quality in California. The SWRCB provides program guidance and oversight, allocates funds, and reviews RWQCB decisions. In addition, the SWRCB has sole responsibility for allocating rights to the use of surface water. The RWQCBs have responsibility for water quality protection, including

individual permitting, inspection, and enforcement actions within each of nine hydrologic regions.

SWRCB and RWQCB programs are designed to carry out the responsibilities of both the Porter-Cologne Act and the Federal Water Pollution Control Act (33 U.S.C. 1251, et seq.), discussed below.¹ The SWRCB and RWQCBs regulate point source and storm water discharges through National Pollutant Discharge Elimination System (NPDES) permits,² and conduct numerous nonpoint source (NPS)-related activities, including monitoring and assessment, planning, financial assistance, and regulatory and non-regulatory management.³

Basin Plans

Each regional board must formulate and adopt water quality control plans (Basin Plans) for all areas within the region. Basin Plans consist of a designation or establishment for the waters within a specified area all of the following:

- 1) Beneficial uses to be protected;
- 2) Water quality objectives; and
- 3) A program of implementation needed for achieving water quality objectives. (Wat. Code, § 13050, subd. (j).)

Dischargers must comply with Basin Plan provisions, as must state agencies. Water Code section 13247 provides that state offices, departments, and boards, in carrying out activities that may affect water quality, must comply with Basin Plans approved or adopted by the SWRCB, unless they are otherwise directed or authorized by statute. But in those cases they must indicate to the RWQCBs in writing their authority for not complying with such plans. (Wat. Code, § 13247.) Additionally, the SWRCB may require any state or local agency to investigate and report on any technical factors involved in water quality control; provided that the burden, including costs, of such reports shall bear a reasonable relationship to the need for the reports and the benefits to be obtained therefrom. (Wat. Code, § 13165.)

¹ “The state board is designated as the state water pollution control agency for all purposes stated in the Federal Water Pollution Control Act and any other federal act, heretofore or hereafter enacted, and is (a) authorized to give any certificate or statement required by any federal agency pursuant to any such federal act that there is reasonable assurance that an activity of any person subject to the jurisdiction of the state board will not reduce water quality below applicable standards, and (b) authorized to exercise any powers delegated to the state by the Federal Water Pollution Control Act (33 U.S.C. 1251, et seq.) and acts amendatory thereto.” (Wat. Code, § 13160.)

² The Federal Water Pollution Control Act provides that a state may be granted authority to issue permits or other appropriate documents that will satisfy its provisions, if the United States Environmental Protection Agency (USEPA) determines that the state has adequate laws to carry out the purposes of the Act. In 1973, the USEPA granted approval to the State of California to issue NPDES permits, finding that the waste discharge requirements provisions under division 7 of the Water Code satisfy federal NPDES permitting requirements. Ever since that date, the State of California through its own water quality protection laws has enacted the NPDES provisions of the Federal Water Pollution Control Act.

³ The Federal Water Pollution Control Act requires states to have approved management programs for nonpoint source pollution and the *Plan for California's Nonpoint Source Pollution Control Program* was recently updated to fulfill this requirement, along with the requirements of the Coastal Zone Act Reauthorization Amendments of 1990. The plan was adopted by the State Board on December 14, 1999, and approved by the US Environmental Protection Agency on July 17, 2000. Key to the program is the implementation of “Management Measures” designed to address specific categories of nonpoint source pollution (i.e., agriculture; urban areas; forestry; marinas and recreational boating; hydro modification; wetlands, riparian areas and vegetated treatment systems). The State is committed to implementing, over a 15-year period, the 61 NPS Management Measures identified in the program. The goal is to have the measures implemented by 2013. There are three 5-year implementation plans for the 15-year period. Implementation of the Management Measures for agriculture is a priority for the first 5-year plan.

Each regional board must establish water quality objectives in Basin Plans that, in its judgment, will ensure the reasonable protection of beneficial uses and the prevention of nuisance. (Wat. Code, § 13241.) Factors a regional board must consider in establishing water quality objectives include, but are not limited to, all of the following:

- a) Past, present, and probable future beneficial uses of water.
- b) Environmental characteristics of the hydrographic unit under consideration, including the quality of water available thereto.
- c) Water quality conditions that could reasonably be achieved through the coordinated control of all factors which affect water quality in the area.
- d) Economic considerations.
- e) The need for developing housing within the region.
- f) The need to develop and use recycled water. (Wat. Code, § 13241.)

The program of implementation in Basin Plans for achieving water quality objectives must include, but are not limited to:

- a) A description of the nature of actions which are necessary to achieve the objectives, including recommendations for appropriate action by any entity, public or private.
- b) A time schedule for the actions to be taken.
- c) A description of surveillance to be undertaken to determine compliance with objectives. (Wat. Code, § 13242.)

There are two Basin Plans for the Central Valley - one for the San Joaquin River and Sacramento River Basins and one for the Tulare Lake Basin. The Basin Plans contain sections addressing both irrigation return flows and storm water. Pesticides and other constituents are also addressed. For example, the Basin Plan for the San Joaquin River and Sacramento River Basins provides details on how the Regional Board will address pesticides in surface waters and site-specific details on the rice pesticide control program.

Antidegradation Policy

A key policy of California's water quality program is the SWRCB's Antidegradation Policy. This policy, formally known as the *Statement of Policy with Respect to Maintaining High Quality Waters in California* (SWRCB Resolution No. 68-16), restricts degradation of surface and ground waters. In particular, this policy protects water bodies where existing quality is higher than necessary for the protection of beneficial uses. (SWRCB, 2000.)

The Antidegradation Policy provides that any actions that can adversely affect water quality in all surface and ground waters must: (1) be consistent with maximum benefit to the people of the State; (2) not unreasonably degrade present and anticipated beneficial use of the water; and (3) not result in water quality less than that prescribed in water quality plans and policies. Furthermore, any actions that can adversely affect surface waters are also subject to the Federal Antidegradation Policy (40 Code of Federal Regulations [CFR] § 131.12.) developed under the Clean Water Act. (SWRCB, 2000.)

The Central Valley RWQCB Basin Plan (1998) includes the following statement regarding pesticide discharges and the antidegradation policy:

“Since the discharge of pesticides into surface waters will be allowed under certain conditions, the Board will take steps to ensure that this control program is conducted in compliance with the federal and state antidegradation policies. This will primarily be done as pesticide discharges are evaluated on a case-by-case basis.” (CVRWQCB, 1998, p. IV-36.00.)

The Federal Antidegradation Policy provides that:

- 1) Existing instream water uses and the level of water quality necessary to protect the existing uses shall be maintained and protected.
- 2) Where the quality of the waters exceed levels necessary to support propagation of fish, shellfish, and wildlife and recreation in and on the water, that quality shall be maintained and protected unless the State finds, after full satisfaction of the intergovernmental coordination and public participation provisions of the State's continuing planning process, that allowing lower water quality is necessary to accommodate important economic or social development in the area in which the waters are located. In allowing such degradation or lower water quality, the State shall assure water quality adequate to protect existing uses fully. Further, the State shall assure that there shall be achieved the highest statutory and regulatory requirements for all new and existing point sources and all cost-effective and reasonable best management practices for nonpoint source control.
- 3) Where high quality waters constitute an outstanding National resource, such as waters of National and State parks and wildlife refuges and waters of exceptional recreational or ecological significance, that water quality shall be maintained and protected. (40 C.F.R. § 131.12 (2001).)

Existing uses are defined as those uses actually attained in the water body on or after November 28, 1975, whether or not they are included in the water quality standards. (40 C.F.R. § 131.3(e) (2001).)

Regulation of Discharges

The RWQCBs implement the Basin Plan by regulating discharges primarily through issuance of Waste Discharge Requirements (WDRs) and NPDES permits. Anyone discharging or proposing to discharge waste⁴ that could affect water quality must file a report of waste discharge (ROWD). (Wat. Code, § 13260.) This includes return flows from irrigated agriculture, which is consistent with the legislative history of the Porter-Cologne Act, in which the term “waste” was used as determined by the Attorney General under the Dickey Act to include irrigation return flows and drainage water from agricultural operations. (27 Ops.Cal.Atty.Gen. 182 (1956); 43 Ops.Cal.Atty.Gen. 302, 304 (1964); 48 Ops.Cal.Atty.Gen. 30, 34 (1966).)

After receipt of a ROWD, the RWQCB has a statutory obligation to prescribe WDRs or an NPDES Permit Order. As noted above, NPDES permits are issued for point source and storm water discharges. Water Code section 13263 sets forth the requirements of WDRs. RWQCBs must prescribe requirements as to the nature of any proposed discharge, existing discharge, or

⁴ The Porter-Cologne Act defines waste as, “sewage and any and all other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, or processing operation, including waste placed within containers of whatever nature prior to, and for purposes of, disposal.” (Wat. Code, § 13050, subd. (d).)

material change in an existing discharge with relation to the conditions in the receiving waters. The requirements must implement any relevant water quality control plans that have been adopted, and take into consideration the beneficial uses to be protected, the water quality objectives reasonably required for that purpose, other waste discharges, the need to prevent nuisance, and the factors that must be considered in establishing water quality objectives.⁵ Section 13263 provides further that:

- The requirements may contain a time schedule, subject to revision in the discretion of the regional board.
- The RWQCBs may prescribe requirements although no discharge report has been filed.
- All requirements shall be reviewed periodically.
- No discharge of waste into the waters of the state, whether or not the discharge is made pursuant to waste discharge requirements, shall create a vested right to continue the discharge. All discharges of waste into waters of the state are privileges, not rights.

The SWRCB or RWQCBs may prescribe general waste discharge requirements for a category of discharges if the SWRCB or RWQCB determines that all of the following criteria apply to the discharges in that category:

- 1) The discharges are produced by the same or similar operations.
- 2) The discharges involve the same or similar types of waste.
- 3) The discharges require the same or similar treatment standards.
- 4) The discharges are more appropriately regulated under general discharge requirements than under individual discharge requirements. (Wat. Code, § 13263, subd. (i).)

The requirement for WDRs may be waived by a RWQCB as to a specific discharge or type of discharge *where such waiver is not against the public interest*. (Wat. Code, §13269, emphasis added.) Waivers are conditional and may be terminated at any time by a regional board, and they require renewal every five years. Waivers in effect January 1, 2000, will sunset on January 1, 2003, unless renewed by the issuing RWQCB. (Wat. Code, § 13269, subd. (b).) Prior to renewing any waiver, the RWQCB must review the terms of the waiver policy at a public hearing, during which it must determine whether the discharge for which the waiver policy was established should be subject to general or individual waste discharge requirements. (Wat. Code, § 13269, subd. (f).)

On 26 March 1982, the Central Valley Regional Water Quality Control Board (CVRWQCB) adopted Resolution No. 82-036 “*Waiving Waste Discharge Requirements For Specific Types Of Discharge*.” The resolution lists the 23 categories of waste discharges and the conditions to meet the waiver policy. Irrigation return water is one of the categories listed in the resolution. Irrigation return water waiver conditions specify that the discharges be operated to minimize sediment to meet Basin Plan turbidity objectives and to prevent concentrations of materials toxic to fish or wildlife. Storm water runoff, which can include runoff from irrigated lands, is also a listed category. Storm water runoff waiver conditions specify that the discharges be done where no water quality problems are contemplated and no federal NPDES permit is required. Unless renewed by the CVRWQCB, the waivers for the categories of discharges set forth in Resolution No. 82-036 will sunset on January 1, 2003, pursuant to Water Code section 13269, subdivision (b).

⁵ These factors are set forth in Water Code section 13241, discussed above.

In addition to being authorized to waive WDRs in appropriate situations, RWQCBs are also authorized to prohibit discharges of waste. A regional board, in a water quality control plan or in waste discharge requirements, may specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted. (Wat. Code, § 13243.)

Enforcement

The Porter-Cologne Act sets forth a number of options for enforcing provisions of the act. They include:

- Time schedule orders (Wat. Code, § 13300)
- Cease and desist orders (Wat. Code, § 13301)
- Cleanup and abatement orders (Wat. Code, § 13304)
- Administrative civil liability (Wat. Code, § 13323)
- Time schedule orders with monetary penalties (Wat. Code, § 13308)

Water Code section 13267 authorizes RWQCBs to conduct investigations and inspections in establishing, reviewing or other actions related to Basin Plans or WDRs. This includes requiring dischargers to furnish technical or monitoring program reports. (Wat. Code, § 13267, subd. (b)(1).)⁶ Further, RWQCBs may inspect facilities to ascertain whether the purposes of the Porter-Cologne Act are being met and verify compliance with WDRs, either with the owner's consent or pursuant to a warrant if consent is withheld. (Wat. Code, § 13267, subd. (c).) The Porter-Cologne Act also provides for civil court actions and criminal prosecutions, whereby cases may be referred by RWQCBs to the Attorney General's Office or a District Attorney's office.

The SWRCB and RWQCBs are authorized to carry out the provisions of the CWA, including the issuance of WDRs as required or authorized by the CWA to ensure compliance with all applicable provisions, together with any more stringent effluent standards or limitations necessary to implement Basin Plans, or for the protection of beneficial uses. (See Water Code, div. 7, ch. 5.5, Compliance With the Provisions of the Federal Water Pollution Control Act As Amended in 1972.) Water Code section 13383 provides that the SWRCB or RWQCBs may establish monitoring, inspection, entry, reporting, and record keeping requirements, as authorized by Water Code section 13377 or section 13383, subdivisions (b) and (c), for any person who discharges pollutants to navigable waters. Further, the SWRCB or RWQCBs may:

- Require subject persons to establish and maintain monitoring equipment or methods, including, where appropriate, biological monitoring methods, sample effluent as prescribed, and provide other information as may be reasonably required. (Wat. Code, § 13383, subd. (b).)
- Inspect the facilities of any person subject to this section pursuant to the procedure set forth in subdivision (c) of Section 13267. (Wat. Code, § 13383, subd. (c).)

Civil liabilities, injunctive relief and criminal penalties, are authorized for violations. (See Wat. Code, §§ 13385, 13386 and 13387, respectively.)

⁶ As with Water Code section 13165, which authorizes the SWRCB to request technical reports related to water quality control from state and local agencies, the burden of Water Code section 13267 reports, including costs, must bear a reasonable relationship to the need for the reports and the benefits to be obtained therefrom.

Federal Water Pollution Control Act (The Clean Water Act)

Public Law 92-500 enacted by the 92nd Congress was the most significant revision to existing water pollution laws in the history of the United States. Enacted as the Federal Water Pollution Control Act Amendments of 1972, it set in motion a major effort to clean up the Nation's waterways. This law was reauthorized and further amended in 1977, and became commonly known as the Federal Clean Water Act (CWA). (USEPA, 2002a.) The United States Environmental Protection Agency (USEPA) is the federal agency responsible for carrying out the provisions of the CWA. The objective of the act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters. To achieve that objective, goals and policies were set forth in CWA § 101(d)⁷ that include, but are not limited to:

- The ultimate national goal is that the discharge of pollutants into the navigable waters be eliminated
- An interim goal is that wherever attainable, water quality provides for the protection and propagation of fish, shellfish, and wildlife and provides for recreation in and on the water
- It is the national policy that the discharge of toxic pollutants in toxic amounts be prohibited
- It is the national policy that areawide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each State
- It is the national policy that programs for the control of nonpoint sources of pollution be developed and implemented in an expeditious manner so as to enable the goals of this chapter to be met through the control of both point and nonpoint sources of pollution

The act established the NPDES program for permitting the discharge of pollutants into the Nation's surface waters from point sources. Under the CWA, a NPDES permit is required for all point discharges of pollutants to surface waters. A point source is a discernible, confined, and discrete conveyance, such as a pipe, ditch or channel. NPDES permits are also required for specified storm water discharges.

At the time of the enactment of the CWA in 1972, irrigation return flows were considered point source discharges under the NPDES Permitting requirements of the CWA. However in 1977, Public Law 95-217 amended the CWA to prohibit the application of the NPDES Permit process to discharges from irrigated agriculture. (See CWA § 402(l)(1).)⁸ The present USEPA definition of return flows from irrigated agriculture is "*surface and subsurface water which leaves the field following application of irrigation water.*" (USEPA, 2002b).

As noted above, the SWRCB and RWQCBs have been granted the authority to carry out provisions of the CWA, including NPDES permitting (see footnotes 1 and 2).

Total Maximum Daily Loads (TMDLs)

States are required to develop TMDLs for all water bodies that are not expected to meet water quality standards even if point sources are regulated to comply with the current level of treatment technology required by law. (CWA § 303(d)).⁹ A TMDL is the maximum amount of a specific

⁷ 33 U.S.C. § 1251.

⁸ 33 U.S.C. § 1342 (l)(1).

⁹ 33 U.S.C. § 1313(d).

pollutant that a water body can receive, from natural background, point sources and nonpoint sources combined, and still maintain a water quality standard. In the State of California, the Regional Water Quality Control Boards have the responsibility for identifying impaired water bodies and completing TMDLs.

2.2.2 Department of Pesticide Regulation and County Agricultural Commissioners

Division 6 and portions of division 7 of the California Food and Agricultural Code (FAC) authorize and set forth the framework for California's pesticide regulatory program. Its purposes are:

- To provide for the proper, safe, and efficient use of pesticides essential for production of food and fiber and for protection of the public health and safety
- To protect the environment from environmentally harmful pesticides by prohibiting, regulating, or ensuring proper stewardship of those pesticides
- To assure agricultural and pest control workers of safe working conditions where pesticides are present
- To permit agricultural pest control by competent and responsible licensees and permittees under strict control of the Department of Pesticide Regulation and the County Agricultural Commissioners
- To assure consumers and users that pesticides are properly labeled and appropriate for the use designated by the label, and that state or local governmental dissemination of information on pesticidal uses of any registered pesticide product is consistent with the uses for which the product is registered
- To encourage the development and implementation of pest management systems, stressing application of biological and cultural pest control techniques with selective pesticides when necessary to achieve acceptable levels of control with the least possible harm to the public health, nontarget organisms, and the environment. (Food & Agr. Code, § 11501.)

Division 7, chapter 3.5 of the FAC has provisions specific to environmentally harmful materials. It provides that the use of environmentally harmful materials must be prohibited or regulated pursuant to division 7 provisions for pesticides and registration (chapter 2, commencing with section 12751) and restricted materials (chapter 3, commencing with section 14001). In so doing, the director of DPR must consider the effect of all such materials upon the environment, and take whatever steps he deems necessary to protect the environment. He must also continue to initiate, cooperate, and collaborate with the University of California and with other state agencies in research designed to reduce and eliminate the use of environmentally harmful materials. (Food & Agr. Code, § 14102.)¹⁰

In 1991, California's environmental authority was unified in a single Cabinet-level agency — the California Environmental Protection Agency (Cal EPA). This brought the Air Resources Board,

¹⁰ “In establishing criteria and regulations relating to environmental injury and protection, and in conducting the reviews required in Chapters 2 and 3, the director must consult with representatives of the Water Resources Control Board, the Departments of Public Health, Fish and Game and Conservation, and four outside experts of his selection from the fields of agricultural, biological, ecological, and medical sciences.” (Food & Agr. Code, § 14103.)

State Water Resources Control Board, and Integrated Waste Management Board under an umbrella agency with the newly created Department of Toxic Substances Control and Office of Environmental Health Hazard Assessment. As part of this reorganization, the pesticide regulation program was removed from the California Department of Food and Agriculture (CDFA) and given departmental status as the Department of Pesticide Regulation (DPR) within Cal EPA. All pesticide-related statutory responsibilities and authorities were transferred to DPR with the exception of the Biological Control Program and the pesticide residue laboratory, which remained with CDFA, and local enforcement duties, which are under the County Agricultural Commissioners. (DPR, 2001, p. 12.)

DPR's oversight of pesticide regulation begins with product evaluation and registration (pursuant to FAC, division 7); and continues through regulation of pest control operations (pursuant to FAC, division 6, which includes statewide licensing of private applicators, commercial applicators, dealers and consultants); environmental monitoring; and residue testing of fresh produce. Their work is augmented by approximately 400 biologists working for County Agricultural Commissioners (CACs) in all 58 counties on local pesticide enforcement. (DPR, 2001, p. 1.)

Where the FAC places joint responsibility for the enforcement of laws and regulations on the Director of DPR and CACs, the CACs are responsible for local administration of the enforcement program. (Food & Agr. Code, § 2281.) The Director of DPR is responsible for overall statewide enforcement, and issues instructions and makes recommendations to the CACs that govern the procedures CACs follow in the discharge of their duties. Further, the director furnishes assistance in planning and otherwise developing an adequate county enforcement program, including uniformity, coordination, training, special services, special equipment, and forms, statewide publicity, statewide planning, and emergency assistance.

Additionally, FAC, division 6 provides that a CAC may adopt regulations applicable in his or her county supplemental to those of the Director of DPR that govern the conduct of pest control operations and records and reports of those operations. The regulations must be filed with, and approved by, the Director of DPR before they become operative.¹¹ (Food & Agr. Code, § 11503.)

Federal and State Preemption

Federal law governs product labeling, while product registration and use are regulated under both federal and state law, and local or county regulation of pesticides is preempted under state law. The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), discussed below, authorizes the USEPA to regulate pesticides. The regulatory framework includes product registration, labeling and use. A state may regulate the sale or use of any federally registered pesticide in the state to the extent the regulation does not permit any sale or use prohibited under FIFRA, however, labeling is regulated strictly at the federal level. (7 U.S.C. § 136v.) Note however, that while DPR cannot require registrants to modify labels, it can refuse to register products for use in California unless registrants address unmitigated hazards by amending the pesticide label. (DPR, 2001, pp. 9, 23; see also p. 32) Under state law, authority for regulation of pesticide use lies with DPR and the CACs. Local governmental entities are prohibited from regulating

¹¹ "The director, in his or her review of the commissioner's regulations, shall consider, but not be limited to considering, the necessity, authority, clarity, and consistency of the regulations, as defined in Section 11349 of the Government Code." (Food & Agr. Code, § 11503.)

pesticides. FAC section 11501.1, subdivision (a), provides that unless specifically provided, no ordinance or regulation of local government, including, but not limited to, an action by a local governmental agency or department, a county board of supervisors or a city council, or a local regulation adopted by the use of an initiative measure, may prohibit or in any way attempt to regulate any matter relating to the registration, sale, transportation, or use of pesticides.

Registration

Once a product is registered with the USEPA, it must also be registered with DPR before it can be offered for sale in the state. (Food & Agr. Code, §12811.) Registration must be renewed annually. (Food & Agr. Code, § 12817.) The Director of DPR must endeavor to eliminate from use in the state any pesticide that endangers the agricultural or nonagricultural environment and must provide for a program for the continuous evaluation of all pesticides actually registered. (Food & Agr. Code, §12824.)

FAC section 12824 further provides:

- Before a substance is registered as a pesticide for the first time, there shall be a thorough and timely evaluation in accordance with the section.
- Appropriate restrictions may be placed upon its use including, but not limited to, limitations on quantity, area, and manner of application.
- All pesticides for which renewal of registration is sought also shall be evaluated in accordance with the section.
- The director may establish specific criteria to evaluate a pesticide with regard to the factors listed in FAC section 12825.
- The department may establish performance standards and tests that are to be conducted or financed, or both conducted and financed, by the registrants, applicants for registration, or parties interested in the registration of those pesticides.

In complying with FAC section 12824, the director, after hearing, may cancel the registration of, or refuse to register, any pesticide:

- a) That has demonstrated serious uncontrollable adverse effects either within or outside the agricultural environment.
- b) The use of which is of less public value or greater detriment to the environment than the benefit received by its use.
- c) For which there is a reasonable, effective, and practicable alternate material or procedure that is demonstrably less destructive to the environment.
- d) That, when properly used, is detrimental to vegetation, except weeds, to domestic animals, or to the public health and safety.
- e) That is of little or no value for the purpose for which it is intended.
- f) Concerning which any false or misleading statement is made or implied by the registrant or his or her agent, either verbally or in writing, or in the form of any advertising literature.
- g) For which the director determines the registrant has failed to report an adverse effect or risk as required by Section 12825.5.
- h) If the director determines that the registrant has failed to comply with the requirements of a reevaluation or to submit the data required as part of the reevaluation of the registrant's product.

- i) That is required to be registered pursuant to the federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. Sec. 136 et seq.) and that is not so registered. (Food & Agr. Code, § 12825.)

In making a determination pursuant to FAC section 12825, the director may require those practical demonstrations that are necessary to determine the facts.

If a registrant has factual or scientific evidence of any adverse effect or risk of the pesticide to human health, livestock, crops, or the environment that has not been previously submitted to the department, the registrant must submit the evidence to the director in a timely manner. (Food & Agr. Code, § 12825.5.) This is required during the registration process or at any time after the registration of a pesticide, and the information required includes, but is not limited to, information required under section 6(a)(2) of FIFRA.¹²

If the director has reason to believe that any of the conditions stated in FAC section 12825 are applicable to any registered pesticide and that the use or continued use of that pesticide constitutes an immediate substantial danger to persons or to the environment, the director, after notice to the registrant, may suspend the registration of that pesticide pending a hearing and final decision.¹³ (Food & Agr. Code, § 12826.) Additionally, the director may cancel a certificate of registration or refuse to issue certification to any manufacturer, importer, or dealer in any pesticide that repeatedly violates any of the provisions of division 7, chapter 2 of the FAC or the regulations of the director.¹⁴ (Food & Agr. Code, § 12827.) Violations of division 7, chapter 2 may be prosecuted regardless of whether the Director of DPR has taken any action on a product registration pursuant to sections 12824, 12825, 12826, or 12827 of the FAC. (Food & Agr. Code, §12828.)

DPR evaluations take into account the varied climatic and cultural conditions in California. These varied conditions can be considered in restricting use of some pesticides to certain areas of California, as opposed to a statewide ban. This may be accomplished by placing restrictions in regulation; by making a pesticide a restricted material and recommending use restrictions to the CACs (discussed below); or by working with the registrant to place California-only instructions on the federally-approved label. (DPR, 2001, p. 23.) The latter option regarding California-only label instructions is discussed further under Special Local Needs – Supplemental Labeling.

DPR sometimes denies registration to products approved by USEPA. It may base such decisions on toxicology or environmental studies judged to be inappropriate or inadequate, label instructions that fail to mitigate possible hazards, or inadequate margins of safety.¹⁵ DPR has also denied State registration for federally registered products that could not show reasonable effectiveness under California conditions, or which did not meet labeling claims. From its

¹² See 7 U.S.C. §136d (a)(2) for federal information requirements.

¹³ An accusation pursuant to chapter 5 (commencing with section 11500) of part 1 of division 3 of title 2 of the Government Code must be filed within 10 days from the date of the notice, or the suspension will be terminated. (Food & Agr. Code, § 12826.)

¹⁴ The proceedings must be conducted in accordance with chapter 5 (commencing with section 11500) of part 1 of division 3 of title 2 of the Government Code. (Food & Agr. Code, § 12827.)

¹⁵ Whenever the director cancels the registration of, or refuses to register, any pesticide currently registered by the USEPA, the director must provide the applicant or registrant with the basis for the decision and the reasons why a conclusion different from the conclusion and findings of the United States Environmental Protection Agency was reached. (Food & Agr. Code, §12827.5.)

review and evaluation, DPR may also impose use restrictions and mitigation measures beyond those listed on labels, either through regulation or through the restricted materials permit system. (DPR, 2001, p. 23.)

Special Local Needs – Supplemental Labeling

Section 24 of FIFRA provides that a state may provide registration for additional uses of federally registered pesticides formulated for distribution and use within that state to meet special local needs in accord with the purposes of FIFRA and if registration for such use has not previously been denied, disapproved, or canceled by the Administrator of the USEPA. This type of registration is deemed registration under title 7 of the United States Code, section 136a for all purposes of FIFRA, but authorizes distribution and use only within that state. (7 U.S.C. § 136v(c).) Special local needs (SLN) registrations are supplemental label instructions for additional uses authorized by DPR. DPR issues two types of registration under section 24(c) of FIFRA: (1) Regular first-party special local needs, and (2) third-party special local needs. (DPR, 1999, p. 109.)

DPR enforcement guidance provides further that:

“First-Party Special Local Needs

These registrations are issued to pesticide manufacturers for either supplementary labeling and product bulletins, or for complete product labels. Such labeling issued under 24(c) can be distinguished by the “EPA SLN NO.” on the label in addition to the regular registration number. These registrations must meet a special local need and may not be issued if:

- There is no applicable residue tolerance established by USEPA.
- That specific use of the pesticide has been canceled, suspended or denied by USEPA.
- The product contains a brand new active ingredient not yet registered by USEPA.”

SLN registrations issued for substantial new use patterns are issued for the full five-year period provided under FIFRA. SLN registrations issued for minor labeling changes that would normally not require extensive data are issued for two years to allow amendment of the manufacturer's USEPA-approved label.”

“Third-party Special Local Need Registrations

These registrations are issued to someone other than the manufacturer, in the form of a notice signed by the Chief of the Pesticide Registration Branch of DPR. These registrations may be applied for through the agricultural commissioner using a Request for Special Local Need Registration *PR-REG 004* and USEPA form *8570-25*.”

“Third-party SLN registrations are issued only when the manufacturer of the product is not willing to apply for a regular SLN. They are subject to the same limitations regarding residue tolerance, cancellation, etc., as a regular SLN registration. In addition, these registrations are not normally issued without the acquiescence of the manufacturer.”

“Like a product bulletin, third-party special local need registrations are for a specific product and must be in possession of the user at the time of application. The third-party SLN registration constitutes the directions for the registered use; therefore, it is essential that the user have the same access to the directions for use and required precautions as when using the pesticide for a normally registered use.”

“Information Regarding Special Local Need Registrations

Copies of third-party SLN registrations are sent to all counties included in the registration. In addition, a monthly summary of all SLN registrations issued is sent to all counties. This report lists each SLN registration issued by an SLN number together with the following information:

- Product name.
- Registrant (manufacturer or other requester in the case of a third-party SLN).
- Area (counties in which the registration is valid).
- Site (the crop or site on which registered).
- Variance (a brief description of the change from the currently registered label). ENF 79-042 Special Local Need Registrations and Emergency Exemptions.”

“If the material is supplied by a certified applicator or a person under their direct supervision, the authorization is completed by utilizing the signature blocks. If the material is applied by a private applicator, a restricted material permit is required.” (DPR, 1999, pp. 109-112.)”

Restricted Materials

Both the USEPA and DPR designate restricted materials. All federally restricted materials (restricted use pesticides) are designated as restricted materials in California by reference in regulation. (Cal. Code Regs., tit. 3, § 6400, subd. (a).) The Director of DPR controls and regulates the use of restricted materials in the state (Food & Agr. Code, §14001.), and it is the director and CACs (under the direction and supervision of the director) that enforce the statutes and regulations governing restricted materials. (Food & Agr. Code, §14004.) The director, by regulation, must designate a list of restricted materials based upon, but not limited to, any of the following criteria:

- a) Danger of impairment of public health.
- b) Hazards to applicators and farmworkers.
- c) Hazards to domestic animals, including honeybees, or to crops from direct application or drift.
- d) Hazard to the environment from drift onto streams, lakes, and wildlife sanctuaries.
- e) Hazards related to persistent residues in the soil resulting ultimately in contamination of the air, waterways, estuaries or lakes, with consequent damage to fish, wild birds, and other wildlife.
- f) Hazards to subsequent crops through persistent soil residues. (Food & Agr. Code, § 14004.5)

The director must also designate, by regulation, a list of "exempt materials" which do not require additional restrictions, beyond registration and labeling requirements, to carry out the purposes of FAC division 7, chapter 3 (the chapter specific to restricted materials). These exempt materials may be used without a permit if the use conforms with the registered label or printed instructions. (Food & Agr. Code, §14006.7.)

The director must adopt regulations governing the possession and use of any restricted material that he or she determines is injurious to the environment. (Food & Agr. Code, §14005.) FAC section 14006 provides that these regulations must prescribe the time when, and the conditions under which, a restricted material may be used or possessed in different areas of the state, and may prohibit its use or possession in those areas. The usage must be limited to those situations

where it is reasonably certain that no injury will result, or no nonrestricted material or procedure is equally effective and practical. This section further specifies that the regulations may provide that a restricted material can only be used under permit of the commissioner or under the direct supervision of the commissioner, subject to any of the following limitations:

- a) In certain areas.
- b) Under certain conditions relating to safety.
- c) When used in excess of certain quantities or concentrations.
- d) When used in certain mixtures.
- e) In compliance with the industrial safety orders of the Department of Industrial Relations and any order of the director or commissioner.
- f) On agreement by the owner or person in possession of the property to be treated to comply with certain conditions.
- g) Any other limitation the director determines to be necessary to effectuate the purposes of [FAC, division 7, chapter 3]. (Food & Agr. Code, §14006.)

Restricted materials can only be possessed by, used by, or used under the supervision of, certified private applicators or certified commercial applicators.¹⁶ (Food & Agr. Code, § 14015.) Federal certification requirements for restricted use pesticides were incorporated into the state restricted material program in 1976, and the USEPA approved state certification requirements for commercial and private pesticide applicators as meeting federal requirements in 1980. (DPR, 2001, p. 47.)

A private applicator is defined as (a) an individual who uses or supervises the use of a pesticide for the purpose of producing an agricultural commodity on property owned, leased, or rented by him/her or his/her employer; or (b) a householder who uses or supervises the use of a pesticide, outside the confines of a residential dwelling for the purpose of controlling ornamental, plant or turf pests on residential property owned, leased, or rented by that householder. (Cal. Code Regs., tit. 3, § 6000.) Private applicators must pass a written examination on the requirements of statutes and regulations concerning pesticide use and pest control operations to receive certification. (Food & Agr. Code, § 14092.) The director can require, by regulation, that pesticide applications must be made by or under the supervision of a person holding a valid qualified applicator certificate. (Food & Agr. Code, §14151.)

In addition to licensing and certification requirements, persons possessing or using a restricted material must also obtain a permit from the CAC, except for certain exceptions provided in FAC section 14006.6. (Food & Agr. Code, § 14006.5.) These permits must comply with the uses designated with the product's registration, unless approval of the director is obtained. Further, no permit can be granted if the commissioner determines that the following subdivisions of FAC section 12825 would be applicable to the proposed use:

- a) That has demonstrated serious uncontrollable adverse effects either within or outside the agricultural environment.

¹⁶ "Certified commercial applicator" means: (a) a person holding a valid qualified license issued by the director; (b) a pilot holding a valid journeyman pest control aircraft pilot's certificate issued by the director; (c) a person holding a certified technician certificate issued by the Vector Biology and Control Section of the Department of Health Services; (d) a person holding a valid structural pest control operator or field representative license issued by the Structural Pest Control Board of the Department of Consumer Affairs; and (e) a person holding a valid qualified applicator certificate by the director. (Cal. Code Regs., tit. 3, § 6000.)

- b) The use of which is of less public value or greater detriment to the environment than the benefit received by its use.
- c) For which there is a reasonable, effective, and practicable alternate material or procedure that is demonstrably less destructive to the environment.

FAC section 14006.5 further provides that each permit issued for any pesticide must include conditions for use in writing and that before issuing a permit for any pesticide the commissioner shall consider local conditions including, but not limited to, the following:

- a) Use in vicinity of schools, dwellings, hospitals, recreational areas, and livestock enclosures.
- b) Problems related to heterogeneous planting of crops.
- c) Applications of materials known to create severe resurgence or secondary pest problems without compensating control of pest species.
- d) Meteorological conditions for use.
- e) Timing of applications in relation to bee activity.
- f) Provisions for proper storage of pesticides and disposal of containers.

Regulations require the CAC to determine if a substantial adverse health or environmental impact will result from the proposed use of a restricted material. If the CAC determines that this is likely, the CAC may deny the permit or may issue it under the condition that site-specific use practices be followed (beyond the label and applicable regulations) to mitigate potentially adverse effects. DPR provides commissioners with information in the form of suggested permit conditions, which reflect minimum measures necessary to protect people and the environment. The commissioners use this information and their evaluation of local conditions to set site-specific limits on applications. To maintain CEQA equivalency, CACs must have flexibility to restrict use permits to local conditions at the time of the application. Therefore, the CACs may follow the DPR-provided guidelines, or may structure their own use restrictions. (DPR, 2001, pp. 48-49.)

A permit is not required for the agricultural use of any pesticide not designated as a restricted material **unless** the commissioner determines that its use will present an undue hazard when used under local conditions. (Food & Agr. Code, § 14006.6, emphasis added.)

FAC section 14007 provides that permits are conditional upon compliance with the FAC and the regulations promulgated to carry out FAC provisions, along with any other conditions that are required to carry out the purposes of laws specific to restricted materials (See Food & Agr. Code, division 7, chapter 3.) These permits are issued on an annual basis, but can be issued up to a three-year period for perennial agricultural plantings (“permanent crops” such as vines and trees), nonproduction agricultural sites, or nonagricultural sites. (Food & Agr. Code, § 14007.) Any permit may be refused, revoked, or suspended for permit condition violations, for violation of applicable statutes or regulations, the failure to pay a civil penalty or comply with any lawful order of the commissioner, once that order is final.¹⁷ (Food & Agr. Code, § 14008.)

The CAC must be notified at least 24 hours prior to commencing the use of a pesticide requiring a permit. The notice of intent to apply a restricted material may be submitted to the CAC by the

¹⁷ FAC section 14009 provides that any interested person may request the commissioner to review his or her action in issuing, refusing, revoking, suspending, or conditioning a permit to use or possess a restricted material.

operator of the property to be treated, by such operator's authorized representative, or by the licensed pest control operator who is to apply the pesticide.¹⁸ (Cal. Code Regs., tit. 3, § 6434.) A pesticide use report must be submitted to the CAC within seven days after each use of a restricted material. (Food & Agr. Code, §14011.5.) Copies of the pesticide use reports received pursuant to FAC section 14011.5, and any other relevant information the director may require must be submitted by CACs to the Director of DPR within one calendar month after they are received. (Food & Agr. Code, § 14012, subd. (b).)

Licensing and Certification for Pest Control Operations

DPR also examines and licenses commercial pest control applicators, aerial applicators, pesticide dealers and brokers, and pest control advisers; and certifies pesticide applicators that use or supervise the use of restricted pesticides. This is done to ensure that persons selling, possessing, storing, handling, applying, and recommending the use of pesticides are knowledgeable in their safe use. These licenses and certificates cannot be renewed unless the holder has completed certain minimum continuing education hours related to pesticides or pest management within each two-year license or certificate period. In addition, pest control businesses, agricultural pest control advisers, and pest control aircraft pilots must register with each county in which they operate. The law provides that the CAC may revoke for cause any registration to work in that county. (DPR, 2001, p. 46.)

Private applicators must also obtain a license for pest control operations. FAC section 11709 provides that a person who is not regularly engaged in the business of pest control, and operates only in the vicinity of his or her own property and for the accommodation of his or her neighbors, need not pay a licensing fee, but must procure a license and register with the commissioner as provided in FAC section 11732, and is subject to all other provisions of FAC, division 6. Also, as discussed above, private applicators must obtain certification to possess, use or supervise the use of restricted materials.

Enforcement

Enforcement options are authorized in multiple chapters of divisions 6 and 7 of the FAC. The following are relevant excerpts from *Regulating Pesticides: The California Story*, DPR, October 2001, which provides a thorough and concise summary of enforcement and compliance options available to DPR and the CACs:

“The legal authority for the pesticide regulatory program is found primarily in Divisions 6 and 7 of the Food and Agricultural Code. These legal provisions and the regulations adopted pursuant to them give DPR, the CACs, or their respective representatives, broad authority to access private property for enforcement activities such as audits, inspections, investigations, sampling, or testing. These laws also authorize DPR and the CACs to discipline violators through various types of sanctions and to protect the public by prohibiting or stopping hazardous activities.”

“Enforcement tools include:

- Administrative civil penalties initiated by a CAC or by DPR.
- Refusal, revocation, or suspension of county registrations or licenses and certificates issued by DPR and a CAC.

¹⁸ The commissioner may allow less than 24 hours notice if he determines that because of the nature of the commodity or pest problem effective pest control cannot be attained or when 24 hours are not necessary to adequately evaluate the intended application.

- Civil and criminal court actions initiated by DPR (through the Attorney General) or local prosecutors.
- Cease-and-desist orders issued by DPR or a CAC.
- Crop seizures issued by DPR (allows seizure and destruction of agricultural commodities or sites treated with a pesticide not registered for use on that commodity or site).“

“Administrative actions: DPR can refuse, revoke or suspend the right of a pest control operator’s or maintenance gardener’s business license to perform pest control, and a pesticide dealer’s business license to sell pesticides. Pest control advisers, licensees and certificate holders who use pesticides are also subject to these administrative actions.”

“County Agricultural Commissioners have the authority to refuse, revoke or suspend the registrations of pest control operators and maintenance gardeners to use pesticides and that of pest control advisers to make pesticide recommendations.”

“In 1985 (Chapter 943, AB 1614) commissioners were granted authority to levy agricultural civil penalties. Commissioners may fine any pesticide user, adviser, or dealer up to \$1,000 per violation of specified sections of the Food and Agricultural Code. In 2000, commissioners were given the authority to refuse, suspend or revoke permits of individuals who disregard fines or lawful orders (Chapter 806, SB 1970).”

“In 1989, DPR was granted limited authority to levy civil penalties (Chapter 843, AB 1873). DPR’s authority at that time was restricted to violations of law prohibiting the sale of unregistered or mislabeled pesticides, and those prohibiting the packing, shipping or selling of produce containing illegal pesticide residues. In 2000, legislation (Chapter 806, SB 1970) expanded that authority to allow DPR to levy civil penalties for serious cases resulting from priority investigations or multi-jurisdictional violations that cannot be handled by a single CAC. DPR-imposed civil fines can range as high as \$5,000 per violation.”

“If DPR and County Agricultural Commissioners believe civil penalties are not warranted, they have an option of obtaining compliance through violation notices, compliance interviews, and warning letters. These less severe actions are generally used to document first-time, nonsubstantive violations. In addition, they can issue “cease and desist” orders to halt activities that may create a hazard involving the use of pesticides in violation of laws or regulations.”

“Criminal and civil actions: Criminal and civil actions can be taken against licensees, certificate holders, permittees, and other pesticide users. These actions can also be taken against pest control advisers, sellers and manufacturers of pesticides. Civil actions can be filed by the State Attorney General or a county district attorney. Criminal penalties range from a minimum of \$500 and/or not more than six months of imprisonment, to \$50,000 and/or imprisonment of one year for offenses involving intentional or negligent violations that created a hazard to human health or the environment. Civil complaints can be filed only by the State Attorney General. Penalties range from \$1,000 to a maximum of \$25,000. Criminal and civil proceedings are considered instead of agricultural or structural civil penalties for repetitive or intentional violations, or violations that have created a hazard to human health or the environment.” (DPR, 2001, pp. 50, 52.).”

2.2.3 U.S. Environmental Protection Agency

This section describes the authorities that USEPA has to regulate the sales and use of pesticides.

Federal Insecticide Fungicide and Rodenticide Act (FIFRA)

A primary focus of FIFRA is to provide federal control of pesticide distribution, sale, and use. The USEPA was given authority under the 1972 amendments to FIFRA to study the consequences of pesticide usage and to require users (farmers, utility companies, and others) to register when purchasing pesticides. Through later amendments to the law, users also must take exams for certification as applicators of pesticides. All pesticides used in the U.S. must be registered (licensed) by the USEPA. Registration is aimed at assuring that pesticides will be properly labeled, and if used in accordance with specifications, will not cause unreasonable harm to humans and the environment. (USEPA, 2002c.)

FIFRA provisions, as set forth in title 7, chapter 6, subchapter II of the United States Code include, but are not limited to:

- Pesticide applicators must follow the label;
- Violations can result in heavy fines and/or imprisonment;
- All pesticides are classified as either restricted use pesticides (RUP) or general use pesticides;¹⁹
- Anyone applying or supervising the use of RUP's must be certified by the State;
- Pesticide manufacturing plants must be registered and inspected by USEPA;
- States may register pesticide products on a limited basis for local special needs;
- All pesticide products must be registered by USEPA;
- When registering a product, the manufacturer is required to provide scientific evidence that the product will effectively control the pests listed on the label, not injure humans, crops, livestock, wildlife, or the environment, and not result in illegal residues in food or feed.

Title 7, United States Code section 136w-1 gives the States primary enforcement responsibility if the State has pesticide use laws that are as stringent as those in FIFRA, the State enforces those laws and keeps records of pesticide use in compliance with FIFRA. California has received authority to implement FIFRA in the state through DPR.

2.2.4 Counties

With regard to pesticides, as discussed above, FAC section 11501.1, subdivision (a) prohibits counties from regulating any matter related to the registration, sale, transportation, or use of pesticides through ordinance or local government regulation. DPR and the CACs are the sole entities authorized to regulate pesticides in the state.

The California Constitution vests cities and counties with broad powers, providing that they may make and enforce within their limits all local, police, sanitary, and other ordinances and regulations not in conflict with general laws. (Cal. Const., art. XI, § 7.) With regard to water, counties are authorized by law to undertake a range of activities to supply their inhabitants with water for domestic, irrigation, agricultural and other beneficial uses. (Gov. Code, §§ 25690-

¹⁹ The "general use pesticides" classification was later changed to "unclassified pesticides."

25699.) Counties are also authorized to undertake works for drainage and reclamation, flood control, and overflow protections. (Gov. Code, §§ 25680-25684.) Additionally, in relation to flood control, the Water Code authorizes counties to expend county general funds for:

- a) The construction of works, improvements, levees or check dam to prevent overflow and flooding.
- b) The protection and reforestation of watersheds.
- c) The conservation of flood waters. (Wat. Code, § 8100.)

There are various types of entities a county may form for water supply, irrigation, management or reclamation. These will be discussed below, along with other water entities.

2.2.5 Water Districts

California law defines a water district as any district or other political subdivision, other than a city or county, a primary function of which is the irrigation, reclamation, or drainage of land or the diversion, storage, management, or distribution of water primarily for domestic, municipal, agricultural, industrial, recreation, fish and wildlife enhancement, flood control, or power production purposes. (Wat. Code, § 20200.) Such districts include, but are not limited to, irrigation districts, county water districts, California water districts, water storage districts, reclamation districts, county waterworks districts, drainage districts, water replenishment districts, levee districts, municipal water districts, water conservation districts, community services districts, water management districts, flood control districts, flood control and floodwater conservation districts, flood control and water conservation districts, water management agencies, and water agencies. (Ibid.)

Generally, in California there are two methods for forming districts: (1) by enactment of a general act under which the districts may be formed in accordance with procedures set forth in the act; and (2) by a special act creating the district and prescribing the powers it will have, its territory and procedural provisions. The California Department of Water Resources (DWR) updated a general comparison of water district acts in 1994 (DWR, 1994), wherein it summarized the 39 general acts and 116 special acts in existence at the time.

The Water Code provides general authority for the following types of districts:

- County Flood Control Districts (division 5, part 1, chapter 2)
- Irrigation Districts (division 11)
- County Water Districts (division 12)
- California Water Districts (division 13)
- California Water Storage Districts (division 14)
- Reclamation Districts (division 15)
- County Waterworks (division 16)
- County Drainage Districts (division 17)
- Water Replenishment Districts (division 18)
- Municipal Water Districts (division 20)
- Water Conservation Districts (division 21)

The purposes of districts vary and in general can include developing water rights; producing, acquiring, transporting, storing, supplying and distributing water for irrigation, domestic,

industrial and municipal purposes; water storage; collecting, treating and disposing of sewage, waste and storm water; water conservation; managing groundwater; hydroelectric power generation; and draining and reclaiming lands.

Some districts have the express authority and have undertaken responsibilities for managing water quality. Water Replenishment Districts have broad authority (even extending beyond district boundaries) to protect groundwater from contamination that is given to water replenishment districts (Wat. Code, §§ 60224-60226). Some districts formed under special act also, among their other roles, undertake water quality management functions for ground water. The Colusa County Flood Control and Water Conservation District has the authority to carry out programs to solve groundwater problems (DWR, 1994, p. 149). The Orange County Water District, in addition to storing, acquiring and distributing water, has authority to improve and protect quality of groundwater supplies (DWR, 1994, p. 250). The San Gabriel Basin Water Quality Authority has authority to undertake projects to correct water quality problems and to adopt a basin-wide groundwater quality management and remediation plan consistent with federal, state and local plans (DWR, 1994, p. 306).

Additionally, surface water quality management has been included in the roles undertaken by some districts formed by special acts. The El Dorado County Water Agency has authority to control and conserve storm and flood waters; and to store, conserve, reclaim, appropriate, acquire, import and protect water (DWR, 1994, p. 169). The Mariposa County Water Agency, in addition to controlling and conserving flood and storm waters; and storing, conserving, reclaiming and importing water; has the authority to prevent contamination (DWR, 1994, p. 213). The Mojave Water Agency includes water protection in its authorities (DWR, 1994, p. 220), as does the Placer County Water Agency (DWR, 1994, p. 259). The Monterey County Water Resources Agency includes protection of water quality in the functions it carries out (DWR, 1994, p. 228). The South Delta Water Agency has the authority to enter into contracts with the United States and California to assure the lands within the agency's jurisdiction have a dependable supply of water of suitable quality sufficient to meet present and future needs (DWR, 1994, p. 349). The Sutter County Water Agency has authority to prevent pollution and contamination of water (DWR, 1994, p. 353), as does the Tuolumne County Water Agency (DWR, 1994, p. 363), and the Yuba-Bear River Basin Authority (DWR, 1994, p. 376).

Numerous flood control and water conservation districts include among their responsibilities the protection of watercourses and watersheds from flood and storm waters. The Contra Costa County Flood Control and Water Conservation District includes this as one of its purposes along with participating in the NPDES program (DWR, 1994, p. 151). Watercourse and watershed protection from flood and storm waters is also a specified purpose for the Lake County Flood Control and Water Conservation District (DWR, 1994, p. 192), the San Bernadino County Flood Control District (DWR, 1994, p. 299), the San Joaquin County Flood Control and Water Conservation District (DWR, 1994, p. 312), the San Luis Obispo County Flood Control and Water Conservation District (DWR, 1994, p. 315), and the Santa Barbara County Flood Control and Water Conservation District (DWR, 1994, p. 320).

While water quality is not specifically stated in relation to the watershed protection from flood and storm water purpose, other flood control districts have provided more specifically for water quality management in their authorities. The Del Norte County Flood Control District is authorized to prevent the unlawful pollution of water (DWR, 1994, p. 162). The Orange County

Flood Control District includes among its authorized purposes water quality monitoring, and control and enhancement of water quality (DWR, 1994, p. 248). Additionally, the San Mateo County Flood Control District includes in its authorities the prevention of pollution or diminution of the water supply (DWR, 1994, p. 318).

The authorities and purposes of water agencies vary and not all provide specifically for drainage or water quality management. The Natural Heritage Institute (NHI) prepared a report for the San Joaquin Valley Drainage Program in 1990 entitled *Legal and Institutional Structures for Managing Agricultural Drainage in the San Joaquin Valley: Designing a Future*. The focus of this report was on addressing salt and trace metal contamination in the San Joaquin River and Tulare Basin, but the analyses and recommendations could have applicability relative to pesticide contamination in surface waters. The report noted that institutional responsibility for drainage management is diffuse and ambiguous, but that the enabling acts for districts do grant express legal authority for districts to provide drainage services. (NHI, 1990, pp. I-2 to I-3.) The report concluded that water supply districts seemed best suited to take a lead role on drainage management for a number of reasons, some of which include:

- The districts are in the best position to implement source control, given they are the dominant suppliers of irrigation water.
- The districts can promote uniform improvements in irrigation practices on the farm.
- The local districts are better able than the water development or regulatory agencies to tailor drainage solutions to the local variables.
- The active cooperation of the districts and growers will be indispensable to a stable solution. That cooperation is most likely to occur if the districts, rather the federal or state agencies are given control over drainage management. (NHI, 1990, pp. I-3 to I-4.)

NHI noted that the district acts should be amended by the legislature to clarify that as an integral part of their purpose and mission, the districts have legal responsibility to reduce, control and provide for the disposal of drainage waters according to laws and regulations governing the fate of these waters in the environment; that the amendments vest legal liability for drainage management in the districts; and that the choice of means be left to the districts themselves, subject only to their achieving performance requirements imposed by the regulatory bodies that govern disposition of drainage contaminants in the environment. (NHI, 1990, pp. I-4.)

In 1992 legislation was enacted which authorized nearly all local water services agencies to adopt groundwater management plans and implement a groundwater management program for basins not already being managed. (Wat. Code, § 10750, et seq.) Among numerous features, groundwater management plans could include regulation of the migration of contaminated groundwater. (Wat. Code, § 10753.7, subd. (c).)

2.2.6 Joint Powers Authority/ Regional Drainage Authority

Government entities in California can establish formal methods of cooperation through a mechanism called a Joint Exercise of Powers Authority (JPA). A JPA can be used by public agencies, including districts, to perform almost any function within the joint authorities of the agencies. Such agreements can be a contractual delegation of authority (empowering an agency to act on behalf of the other parties) or provide for the creation of a new entity to carry out the goals of the agencies party to the JPA. An advantage of JPAs is that they can provide a structure for conducting a range of activities through an independent entity, while leaving internal

structure and procedural operations of participating districts intact, eliminating the need for reorganization of districts which might otherwise be needed to address specific functions or activities. (NHI, 1990, appendix C, p. 2.)

An example is the San Luis & Delta-Mendota Water Authority (SLDMWA), established in January of 1992. It consists of 32 water agencies representing approximately 2,100,000 acres of federal and exchange water service contractors within the western San Joaquin Valley, San Benito and Santa Clara counties. A primary purpose of establishing the SLDMWA was to assume the operation and maintenance responsibilities of certain United State Bureau of Reclamation (USBR) Central Valley Project facilities, with the goal of managing the facilities more efficiently and at a lower cost than the USBR. The SLDMWA also develops, provides and disseminates information to legislative, administrative and judicial bodies on a variety of issues such as: Sacramento and San Joaquin Delta water exports, water supply, water quality, water development, conservation, distribution, drainage, contractual rights, surface and groundwater management. The SLDMWA also played an instrumental role in the December 15, 1995, Bay-Delta Accord and developing legislation passed in 1996 by California voters as Proposition 204 - The Safe, Clean, Reliable Water Supply Act. (SLDMWA, 2002.)

The SLDMWA is a participant in the Grassland Bypass Project. This project involves the coordination and cooperation of multiple state and federal entities with overlapping authorities, interests or activities, including USBR, U.S. Fish and Wildlife Service (USFWS), U.S. Geological Survey (USGS), USEPA, CVRWQCB, California Department of Fish and Game (CDFG), and the SLDMWA. The SLDMWA is responsible for controlling agricultural drainage water flows to and from the bypass, the CVRWQCB sets and enforces water quality regulations, and the USBR, as owner of the bypass, is responsible for decisions regarding the use of the facility and compliance with Use Agreement No. 6-07-20-w1319, signed on November 3, 1995, between USBR and the SLDMWA. An oversight committee comprised of representatives from USBR, USFWS, CDFG, CVRWQCB, and the USEPA assists with decisions regarding the project and evaluates all operations of the project including monitoring and compliance with selenium load reduction goals. Sediment and water quality monitoring, biota sampling and toxicity testing are carried out or overseen by project participants. (SFEI, 2002.)

2.3 Implementation Framework Alternatives

2.3.1 Potential Alternatives and Potential Basin Plan Language

As discussed in section 2.2.1.1, Porter-Cologne provides four basic alternatives for the regulation of discharges of waste (including runoff) into surface waters: 1) not allowing discharge of waste in certain areas or under certain conditions (i.e. – a prohibition under Wat. Code, § 13243); 2) issuing waste discharge requirements (Wat. Code, § 13263); 3) conditionally waiving waste discharge requirements (Wat. Code, § 13269); and 4) issuing cleanup and abatement orders (Wat. Code, § 13304).

This discussion will focus on alternatives 1-3, which could be described as part of a Basin Plan Amendment. Alternative 4 is generally applied to geographically isolated pollution problems and not to watershed-wide issues addressed in the Basin Plan, so it is not reviewed.

Each of the potential alternatives presumes that the Regional Board will continue to be responsible for providing ultimate assurance that progress is being made towards meeting water

quality objectives. Some of the options would allow for another entity to directly oversee a program to reduce diazinon and chlorpyrifos runoff. The entity providing direct oversight would be responsible for encouraging or requiring changes in management practices and reporting progress to the Regional Board.

Within each basic alternative are a number of options, which are briefly summarized in table 2.1. Examples of the type of language that could appear in the Basin Plan are then provided to illustrate how a given option might be implemented. **Since the example Basin Plan language is for illustrative purposes only, it does not constitute a proposal nor does it imply an endorsement of a particular approach by the Regional Board or Regional Board staff. Regional Board staff is interested in comments on the alternatives described as well as suggestions for other alternatives that would be consistent with Porter-Cologne.**

Table 2.1 Potential Alternatives and Entities Responsible for Direct Oversight of Implementation

Alternative	Entity Responsible for Direct Oversight of Implementation			
	Stakeholder Group	Local District	USEPA/ DPR/ CAC	Regional Board
1. Prohibition of Discharge				
1.a.1 All surface waters				X
1.a.2 Tributaries				X
1.b.1 Conditional – management plan submittal	X			
1.b.2 Conditional – management plan submittal				X
1.b.3 Conditional – DPR/USEPA action			X	
2. WDRs				
2.a.1 Individual WDRs				X
2.a.2 Individual WDRs		X		
2.b.1 General WDRs			X	
2.b.2 General WDRs				X
3. Waiver of WDRs				
3.a.1 management plan submittal	X			
3.a.2 management plan submittal				X
3.a.3 DPR/USEPA Action			X	

Alternative 1 – Prohibition of Discharge

Section 13243 of Porter-Cologne states “A regional board, in a water quality control plan or in waste discharge requirements, may specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted.” The options below describe specific ways in which the conditions in a prohibition could be described.

Option 1.a.1 – The Regional Board could prohibit the discharge of diazinon and chlorpyrifos to all surface waters. An example prohibition would be “Discharge of irrigation return flows or storm water runoff into a community drainage system or individually owned drainage system tributary to a natural stream is prohibited, unless such discharge contains diazinon and chlorpyrifos levels less than or equal to the established diazinon and chlorpyrifos water quality objective for the San Joaquin River.”

Option 1.a.2 – The Regional Board could prohibit the discharge of diazinon and chlorpyrifos from certain areas into major waterways. An example prohibition would be “Discharge of diazinon and chlorpyrifos from tributaries directly discharging to the San Joaquin River is prohibited, unless such discharge contains diazinon and chlorpyrifos levels less than or equal to the established water quality objectives.”

Option 1.b.1 – The Regional Board could condition a prohibition of discharge based on the submission of a management plan by an entity (such as a stakeholder group) willing to assume responsibility for meeting water quality objectives. An example conditional prohibition would be “Discharge of irrigation return flows or storm water runoff containing diazinon and chlorpyrifos is prohibited unless the discharger is following a management plan approved by YYY (name of group taking responsibility). The prohibition will be in effect if the diazinon and chlorpyrifos runoff management strategy submitted by YYY is not approved by the Executive Officer in accordance with the provisions in Section ZZZ.” A separate section of the Basin Plan would define the contents and approval process for the management strategy.

Option 1.b.2 – The Regional Board could condition a prohibition of discharge based on Regional Board approval of management practices proposed by the discharger. “Discharge of irrigation return flows or storm water runoff containing diazinon or chlorpyrifos is prohibited unless the discharger is following a management practice or management practices approved by the Regional Board.” The process for Regional Board approval of management practices would be defined in a separate section of the Basin Plan.

Option 1.b.3 - The Regional Board could condition a prohibition of discharge based on regulatory action by another agency that is designed to meet water quality objectives. An example conditional prohibition would be: “Discharge of irrigation return flows or storm water runoff containing diazinon and chlorpyrifos is prohibited after (put in date here) unless the California Department of Pesticide Regulation or United States Environmental Protection Agency amends the regulations governing the use of those pesticides in a manner designed to attain the water quality objectives for diazinon and chlorpyrifos.” A separate section of the Basin Plan would define the allowable time schedule for DPR or USEPA action and the process for the Executive Officer or Regional Board to review any proposed DPR or USEPA action for consistency with attaining the water quality objective.

Alternative 2 – Waste Discharge Requirements

Section 13263 of Porter-Cologne requires the Regional Board to prescribe requirements as to the nature of any discharge into the waters of the state. Waste discharge requirements can be issued to an individual operation/entity or to a category of discharges.

Option 2.a.1 – The Regional Board could require all agricultural applicators of diazinon and chlorpyrifos to submit a report of waste discharge and the Regional Board would issue waste discharge requirements. Example Basin Plan language would be: “Diazinon and chlorpyrifos effluent limits established in waste discharge requirements will be applied to discharges of irrigation return flow and storm water from agricultural land upon which diazinon and chlorpyrifos are applied. Waste discharge requirements will be issued to the owner and farm manager of the agricultural field upon which diazinon and chlorpyrifos are applied.”

Option 2.a.2 – The Regional Board could require all local districts that manage or maintain canals that convey irrigation return flows or storm water flow to submit a report of waste discharge and the Regional Board would issue waste discharge requirements. Example Basin Plan language would be: “Diazinon and chlorpyrifos effluent limits established in waste discharge requirements will be applied to discharges of irrigation return flow and storm water from agricultural districts within which diazinon and chlorpyrifos are applied. Waste discharge requirements will be issued to those districts that have responsibility for the management or maintenance of canals that convey irrigation return flows or storm water flow.”

Option 2.b.1 – The Regional Board could require all agricultural users of diazinon and chlorpyrifos to follow approved management practices established by DPR and or the Agricultural Commissioners in order to fall under general waste discharge requirements. Example Basin Plan language would be: “The Regional Board will establish general waste discharge requirements for discharges of irrigation return flow and storm water from agricultural land upon which diazinon and chlorpyrifos are applied. Provisions of the general waste discharge requirements will include, but are not limited to, a requirement that dischargers (land owners and farm managers) submit a Pesticide Runoff Minimization Plan (PRMP) to their local County Agricultural Commissioner and receive approval of that plan prior to application of any diazinon and chlorpyrifos. Failure to submit and receive approval of the PRMP and or implement the PRMP will result in issuance of individual waste discharge requirements by the Regional Board.”

Option 2.b.2 – The Regional Board could require all agricultural users of diazinon and chlorpyrifos to follow a management plan approved by the Regional Board in order to fall under general waste discharge requirements. Example Basin Plan language would be: “The Regional Board will establish general waste discharge requirements for discharges of irrigation return flow and storm water from agricultural land upon which diazinon and chlorpyrifos are applied. Provisions of the general waste discharge requirements will include, but are not limited to, a requirement that dischargers (land owners and farm managers) submit a Pesticide Runoff Minimization Plan (PRMP) to the Regional Board and receive approval of that plan prior to application of any diazinon or chlorpyrifos. Failure to submit and receive approval of the PRMP and or implement the PRMP will result in issuance of individual waste discharge requirements and other action deemed appropriate by the Regional Board.” Separate provisions of the Basin Plan would need to be developed to identify a time schedule for development of the general WDRs, as well as any guidance that would need to be established to assist growers in developing a PRMP.

Alternative 3 – Waiver of Waste Discharge Requirements

Section 13269 of Porter-Cologne allows the Regional Board to conditionally waive the requirements that discharges to waters of the State be governed by waste discharge requirements for specific types of discharges if the waiver is not against the public interest. Waivers of waste discharge requirements could be developed along similar lines as a conditional prohibition, with the difference being that waste discharge requirements would be issued if the waiver conditions were not met.

Option 3.a.1 - The Regional Board could condition a waiver of waste discharge requirements based on the submission of a management plan by an entity (such as a stakeholder group) willing to assume responsibility for meeting water quality objectives. An example waiver policy would be: under Type of Waste Discharge “Irrigation return flows or storm water runoff containing diazinon and chlorpyrifos” and under Limitations “Where the applicator and or farm manager responsible for diazinon and chlorpyrifos application is following a management plan approved by YYY (name of group taking responsibility). Waste discharge requirements are required if the diazinon and chlorpyrifos runoff management strategy submitted by YYY is not approved by the Executive Officer in accordance with the provisions in Section ZZZ.” A separate section of the Basin Plan would define the contents and approval process for the management strategy.

Option 3.a.2 – The Regional Board could condition a waiver of waste discharge requirements based on submission of a management plan to the Regional Board. An example waiver policy would be: under Type of Waste Discharge “Irrigation return flows or storm water runoff containing diazinon and chlorpyrifos” and under Limitations “Where the applicator and or farm manager responsible for diazinon and chlorpyrifos application is following a management plan approved by the Regional Board (or executive officer).” The contents of the management plan and any process details (e.g. how often they need to be submitted) would be described separately.

Option 3.a.3 - The Regional Board could condition a waiver of waste discharge requirements based on regulatory action by another agency that is designed to meet water quality objectives. An example waiver policy would be: under Type of Discharge “Irrigation return flows or storm water runoff containing diazinon and chlorpyrifos” and under Limitations “Where the County Agricultural Commissioner, California Department of Pesticide Regulation, or United States Environmental Protection Agency amends the regulations governing the use of diazinon and chlorpyrifos in a manner designed to attain the water quality objectives for diazinon and chlorpyrifos.” A separate section of the Basin Plan would define the allowable time schedule for County Agricultural Commissioner, DPR or USEPA action and the process for Executive Officer or Regional Board review of any proposed County Agricultural Commissioner, DPR, or USEPA action.

Potential Options for the Department of Pesticide Regulation and the County Agricultural Commissioners within the Implementation Framework Alternatives

As discussed in section 2.2.2, the Department of Pesticide Regulation and the County Agricultural Commissioners share the responsibility of ensuring pesticides are used in a manner that protects human health and the environment. The authorities of DPR and the CACs could be applied in a manner that complements and supports the water quality objectives and program of implementation that will be adopted by the Regional Board.

The broad frameworks under which the authorities of Porter-Cologne and the Food and Agricultural Code (FAC) could be brought to bear are described under options 1.b.3, 2.b.1, and 3.a.3. In order to adopt one of those options, the authorities to be used by DPR and the CACs would need to be identified.

The specific regulatory authorities that DPR and the CACs could apply to control diazinon and chlorpyrifos use (as described in section 2.2.2) include: A) making diazinon and chlorpyrifos a state-restricted material and implementing local permit conditions; B) making diazinon and chlorpyrifos a state-restricted material and adopting use requirements; C) adopting county specific use requirements; D) canceling, suspending or not registering specific uses of diazinon or chlorpyrifos; or E) developing Special Local Needs label restrictions in conjunction with the registrants (under section 24(c) of FIFRA) (Option E is not a direct DPR or CAC authority, but DPR and the CACs can also work with the registrants to amend the label.

Options A and B would require DPR to go through a rule-making process to designate diazinon and chlorpyrifos as a state-restricted material; option C would require a county-specific determination that diazinon and chlorpyrifos present undue hazards when used under local conditions; the authorities under option D would require DPR to take an administrative action; and option E would require joint action by DPR and the registrant.

With the exception of Option D, the other options available to DPR and the CACs could be designed in a manner that reflects the state of knowledge regarding mitigation of diazinon or chlorpyrifos runoff. For example, under options A, C, and E, use requirements could be amended from year-to-year as the effectiveness of specific management practices becomes known. If the effectiveness of only a few practices is known, initial requirements might focus on reporting of management practices being used. This would allow DPR, the CACs, and the Regional Board to gain an understanding of baseline conditions and to evaluate the effectiveness of various management practices being employed.

2.3.2 Evaluation Criteria for Implementation Framework Alternatives

In developing a recommended implementation framework, Regional Board staff will consider a number of factors in evaluating the various alternatives. The proposed evaluation criteria that staff will consider are described below.

Feasibility – evaluation of feasibility will be based on: 1) the degree to which a given alternative has a clearly defined process; and 2) the degree to which any constraints/requirements associated with the alternative are likely to be met.

Time Needed to Implement the Alternative – certain alternatives will depend on additional regulatory actions by the Regional Board or other entities or may require time to develop the implementation infrastructure (e.g. for a program that is not currently in place). An estimate of the time required to establish the implementation framework of a given alternative will be made.

Accountability - the Regional Board will need to know who is responsible for ensuring that necessary changes in management practices are made and who is responsible for tracking and reporting on the progress of the implementation program. This criteria will evaluate whether the party(ies) accountable for implementation are clearly identified for a given alternative, and whether those party(ies) have the willingness, ability and authority to ensure implementation.

Flexibility – this criteria will evaluate the degree to which a given alternative can be responsive to or adapt to new data and information.

Limitations on Pesticide Use and Pest Management Options – this criteria will evaluate the degree to which a given alternative could limit a grower’s options with respect to pesticide use and pest management.

Certainty in Meeting Water Quality Objectives - this criteria will evaluate the degree of certainty in meeting water quality objectives associated with a given alternative.

Government Cost – this criteria will evaluate the relative cost to local and state governments to implement a given alternative. Cost considerations will include: cost, if any, to develop new regulations or regulatory programs; cost associated with compliance and enforcement; and cost associated with monitoring and reporting.

Grower Cost – this criteria will evaluate the relative cost to growers to operate under a given implementation framework. Costs associated with any requirements to adopt specific management methods/practices and any additional administrative cost will be considered.

Registrant Cost – this criteria will evaluate the relative cost to the registrants of diazinon and chlorpyrifos of a given implementation framework. The costs considered will include potential changes in use as well as other potential costs, such as requirements to submit data or monitor.

Consistency with State and Federal Laws and Policies – the implementation framework will need to be consistent with the existing state and federal laws and policies described below.

Porter-Cologne – as described above, Porter-Cologne requires the establishment of a program of implementation to meet water quality objectives. Porter-Cologne provides the Regional Boards with three general mechanisms for regulating the discharge of waste to waters of the state – waste discharge requirements; waivers of waste discharge requirements; and conditional prohibitions of discharge. The alternatives will be evaluated with respect to their consistency with the regulatory framework described in Porter-Cologne.

Nonpoint Source (NPS) Management Plan – the Nonpoint Source Management Plan includes a three-tier process for implementation of best management practices: Tier 1: Self-Determined Implementation of Management Practices [formerly referred to as “voluntary” implementation]; Tier 2: Regulatory Based Encouragement of Management Practices; and Tier 3: Effluent Limitations and Enforcement Actions. The lowest “tier” that is likely to result in attainment of water quality standards is to be used. Higher “tiers” are to be used for persistent or more difficult water quality problems. “Tier 1” relies on voluntary efforts to adopt improved management practices; “tier 2” relies on incentives such as waivers of WDRs to encourage adoption of management practices; and “tier 3” relies on adoption and enforcement of waste discharge requirements.

DPR/State Board Management Agency Agreement – the Department of Pesticide Regulation and the State Water Resources Control Board have signed a Management Agency Agreement that provides a framework for the agencies to work together on water quality problems caused by registered pesticides. The agreement envisions a four- stage process that includes pollution

prevention efforts during stage 1; self-determined compliance efforts led by a sponsor or sponsors during stage 2; DPR regulatory action in stage 3; and Regional Board or State Board action for stage 4. Stages 2-4 apply when a water quality problem has been identified. Stage 3 is triggered if a sponsor has not been identified or the sponsor's program is not successfully addressing the water quality problem. Stage 4 applies when the Regional Board determines that it is necessary to use its authorities or when DPR is unable to address a water quality problem using its authorities.

Bay Protection Toxic Hot Spots Cleanup Program – the Regional Board is required to develop a clean-up plan for the Delta under the Bay Protection Toxic Hot Spots Program. The implementation alternative must be consistent with the clean-up program for orchard dormant spray runoff.

CALFED Bay-Delta Program- the CALFED Bay-Delta Program Ecosystem Restoration Program includes a goal to: “Improve and/or maintain water quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people.” The implementation alternative should be consistent with this goal.

Basin Plan Policies – currently the Regional Board's Basin Plan includes a policy for “Pesticide Discharges from Nonpoint Sources”. The following statements in this policy must be considered in selecting an implementation alternative include:

- 1) “The control of pesticide discharges to surface waters from nonpoint sources will be achieved primarily by the development and implementation of management practices that minimize or eliminate the amount discharged.”
- 2) “When the Board determines that despite any actions taken by DFA²⁰ use of the pesticide may result in discharge to surface waters in violation of the objectives, the Board will take regulatory action, such as adoption of a prohibition of discharge or issuance of waste discharge requirements to control discharges of the pesticide. Monitoring may be required to verify that management practices are effective in protecting water quality.”
- 3) “The Board will conduct reviews of the management practices being followed to verify that they produce discharges that comply with water quality objectives.”
- 4) “...the Board will place the pesticides into one of the following three classifications...
1. Where the Board finds that pesticide discharges pose a significant threat to drinking water supplies or other beneficial uses, it will request DFA to act to prevent further impacts. If DFA does not proceed with such action(s) within six months of the Board's request, the Board will act within a reasonable time period to place restrictions on the discharges. 2. Where the Board finds that currently used discharge management practices are resulting in violations of water quality objectives, but the impacts of the discharge are not so severe as to require immediate changes, dischargers will be given three years, with a possibility of three one year time extensions depending on the circumstances involved, to develop and implement practices that will meet the objectives. During this period of time, dischargers may be required to take interim steps, such as meeting Board established performance goals to reduce impacts of the discharges.

²⁰ The Department of Food and Agriculture (DFA) was originally responsible for overseeing pesticide registration and use. That responsibility is now with the Department of Pesticide Regulation. Any reference to DFA, therefore, now applies to the Department of Pesticide Regulation.

Monitoring will be required to show that the interim steps and proposed management practices are effective. 3. The Board may approve the management practices as adequate to meet water quality objectives. After the Board has approved specific management practices for the use and discharge of a pesticide, no other management practice may be used until it has been reviewed by the Board and found to be equivalent to or better than previously approved practices. Waste discharge requirements will be waived for irrigation return water per Resolution No. 82-036 if the Board determines that the management practices are adequate to meet water quality objectives and meet the conditions of the waiver policy. Enforcement action may be taken against those who do not follow management practices approved by the Board.”

- 5) “Wherever possible, the burdens on pesticide dischargers will be reduced by working through the DFA or other appropriate regulatory processes. The Board may also designate another agency or organization as the responsible party for the development and/or implementation of management practices, but it will retain overall review and control authority.”

2.3.3 Implementation Activities

The implementation framework alternatives discussed in section 2.3.1. focus on a description of the authorities under Porter-Cologne that could be applied and the potential lead entity in a program to control diazinon and chlorpyrifos runoff. The entity or group (including the Regional Board) that is ultimately assigned responsibility for direct oversight of the program of implementation will still need a great deal of support and the active participation of numerous individuals and groups.

It is anticipated that assistance and participation will be needed for the following implementation activities: 1) education and outreach to the grower community; 2) research and demonstration of new or developing management practices; 3) technical assistance for the adoption of existing or new management practices; 4) monitoring (see section 4 for potential monitoring activities); 5) technical/ peer review of program activities; and 6) funding.

There are many groups and individuals that could contribute significantly to the success of the implementation program by participating in one or more of the activities identified above. This network supporting implementation could include the San Joaquin River – Agricultural Implementation Group (AIG), commodity boards, universities, the cooperative extension, the county and state Farm Bureaus, the County Agricultural Commissioners, the Department of Pesticide Regulation, the Department of Food and Agriculture, pesticide dealers and registrants, the CALFED Bay-Delta Program, pest control advisors, consultants, watershed groups, and many other governmental and non-governmental organizations.

It will be important for the entity taking the lead to develop and implement a strategy for soliciting the involvement of these various groups and individuals. The strategy will likely need to include a process for getting firm commitments for participation and will likely require the development or identification of a forum for the various participants to plan implementation activities and communicate results. The details of the roles and responsibilities for various participants would also need to be established.

3 Evaluation of Practices

This section examines viable agricultural management practices that are likely to be effective in reducing offsite movement of diazinon and chlorpyrifos into surface water. Management practices are practices that provide favorable levels of pest control at costs acceptable to growers, when compared to conventional dormant oil (DO) and diazinon and chlorpyrifos applications. There are two seasons of diazinon and chlorpyrifos use in the San Joaquin River Basin. The major types of management practices available for use in these two seasons are:

- ❑ Pesticide application practices
- ❑ Pest management practices
- ❑ Vegetation management practices
- ❑ Field crop management practices
- ❑ Water management practice

The first two types of management practices are applicable mostly to the dormant season. Vegetation management practices, including conservation buffers, are permanent installations designed to reduce pesticide runoff during both irrigation and dormant seasons. Field crop management practices and water management are most applicable to irrigation season uses although some water management practices may also be used effectively in the dormant season.

The following sections describe the potential of each practice to protect surface water, its pest management efficacy, and its approximate cost. More detailed descriptions of the practices examined here are presented in the Agricultural Practices and Technologies Report (Reyes and Menconi, 2002).

3.1 Pesticide Application Practices

Pesticide application practices include proper mixing and loading of pesticides into application equipment, use of adjuvants to increase surface tension or drop size, and reduce drift, calibration of nozzles and pressure regulators to ensure accurate flow, and other techniques and equipment that help ensure that pesticides land on their targets and stay there. Although spills are relatively infrequent occurrences, they can have significant and immediate impacts on water quality, and measures that reduce the likelihood of spills, leaks, and other inadvertent discharges are important for water quality protection. In addition, application practices such as drift control, proper mixing/loading practices, accurate calibration, and improved spray equipment can help reduce pesticide runoff. These application procedures are discussed in detail in the Agricultural Practices and Technology Report and will not be described again here, however, the potential impacts and relative costs of those procedures are discussed below.

Although runoff is likely the main source of pesticides in surface water, aerial drift (pesticide droplets landing outside the target area) also contributes to the problem. However, efforts to reduce aerial drift by increasing droplet size can result in more ground deposition within the field. This fallout can then easily be transported into surface water by rain or irrigation runoff. Thus, some efforts to reduce drift by increasing droplet size may increase diazinon concentrations in field runoff (Matthews and Thomas, 2000).

Dormant season applications to orchards in the San Joaquin River Valley are made by either ground or aerial equipment, depending on orchard floor conditions. In very wet years or in

orchards with heavy soils, aerial applications must be used because ground equipment cannot be driven over wet soils. Aerial applications are made by pest control operators (PCOs). Ground applications may be made by PCOs, or by growers. Applications made by PCOs, or by growers with large acreages, are likely to be made by modern equipment that is well maintained and calibrated, because it is a substantial cost saving to the grower or PCO to minimize the amount of pesticide used. PCOs must also be licensed, which requires passing an examination and attending annual educational events on pesticide application technology and other topics. In smaller orchards where applications are made by the grower, older, less efficient, or poorly calibrated equipment is more likely to be used because the incremental cost of additional pesticide is less than the cost of equipment maintenance and calibration. (pers. comm. S. Shearer, B. Voorhees).

The costs of improving pesticide mixing and loading procedures vary from inexpensive (training, planning, site selection) to very expensive (construction of cement containment pads and collection sumps for mixing/loading). Changes in pesticide application procedures also vary considerably in cost. For example, the use of drift retardants would be a minor increase in the cost of the spray mix. However, leaving 50 to 150 feet of orchard as an untreated buffer zone might not only reduce yields in those areas, but might also provide refuge for pests to re-infest treated areas. As a worst-case scenario, removing trees from a 50-foot corridor along waterways could potentially remove significant amounts of land from production. This could amount to 2 to 3 rows of productive trees, assuming a minimum of 15-foot row spacing, and an existing field edge of 5 to 20 feet. Financial incentives would be needed to encourage adoption of the more expensive alternative. Because these untreated buffer zones could also provide refuge for beneficial insects, it is difficult to assess the potential mitigation this would provide.

New spray technologies and application equipment would entail a significant financial investment for growers and applicators. However, new technology can result in savings in chemical and application costs. Such benefits, perhaps coupled with low interest loans or grants, could provide incentive for growers to make the investments. Adopting new spray technology throughout the watershed would require several years. However, other improved application practices, such as selecting mixing/loading sites that pose a reduced risk of pesticide runoff, or calibrating spray equipment more frequently, could be implemented immediately.

3.2 Pest Management Practices

Pest management practices are the techniques used to limit pest damage to economically acceptable levels. Viable pest management must be economically feasible, that is, the cost of control must be in keeping with the profit earned from the crop, and must also be in keeping with the agronomic practices used in the orchard.

3.2.1 Current Pesticide Use Patterns

California Department of Pesticide Regulation (DPR) Pesticide Use Reports (PUR) were used to determine the major crops on diazinon and chlorpyrifos are applied, and their seasonality of use. Note that only PUR data for the counties of Merced and Stanislaus were used. Although portions of Fresno, Madera and San Joaquin are included in the TMDL area of interest, these counties are not included in this evaluation of PUR data.

Pesticide use reports covering the six-year period from 1995 through 2000 were used to assess changes in crop types and pesticide use. Data from earlier use reports was not used due to

unacceptable rates of under or over reporting. DPR started performing new quality control checks in 1996, when data records were checked for outliers. The data were analyzed to determine the top fifteen crops showing the highest usage of chlorpyrifos and diazinon (Tables 3.1 and 3.2).

Table 3.1 Chlorpyrifos crop use.

CROP	1995 (lbs. of active ingredient)	1996 (lbs. of active ingredient)	1997 (lbs. of active ingredient)	1998 (lbs. of active ingredient)	1999 (lbs. of active ingredient)	2000 (lbs. of active ingredient)	Annual average in lbs of active ingredient (% of total)
Alfalfa	57,770	43,971	34,890	38,461	20,971	26,653	37,119 (16)
Almond	74,145	101,005	106,087	111,320	78,234	88,633	93,237 (39)
Apple	14,624	11,907	12,298	14,573	6,574	3,934	10,652 (5)
Asparagus	194	2,699	1,800	112	1,739	2,457	1,500 (<1)
Broccoli	884		232		1,397	161	446 (<1)
Citrus Fruits (unspecified)	714	706	713	1,030	427	984	762 (<1)
Corn (forage/fodder)	12,382	7,129	11,055	7,593	10,919	11,563	10,107 (4)
Cotton	112,365	22,962	42,630	21,552	16,962	16,643	38,852 (16)
Grapes (table)		508	1,805	5,659	3,415	2,300	2,281 (1)
Grapes (wine)	4	183	39	1,172	531	784	452 (<1)
Orange	3,929	2,699	1,774	4,971	5,771	2,014	3,526 (2)
Peach	1,161	1,505	473	1,215	982	849	1,031 (<1)
Sugarbeet	3,376	3,343	4,614	6,105	6,331	3,052	4,470 (2)
Sweet Potato	1,040	1,699	3,155	2,983	5,366	3,924	3,037 (1)
Walnut (English, Persian)	33,109	33,165	29,037	27,850	24,547	23,520	28,538 (12)
Other	1,443	1,527	2,629	3,582	2,327	1,879	2,231 (1)
Total	317,140	235,008	253,231	248,178	186,493	189,350	238,233

Table 3.2. Diazinon crop use.

CROP	1995 (lbs. of active ingredient)	1996 (lbs. of active ingredient)	1997 (lbs. of active ingredient)	1998 (lbs. of active ingredient)	1999 (lbs. of active ingredient)	2000 (lbs. of active ingredient)	Annual average in lbs. of active ingredient (percent of total)
Alfalfa	2,912	3,178	186	302	0	0	1,096 (2)
Almond	59,491	48,584	28,112	31,504	34,846	11,761	35,716 (52)
Apple	4,714	4,349	2,914	1,251	1,468	1,271	2,661 (4)
Apricot	6,565	5,553	1,997	4,378	3,430	2,978	4,150 (6)
Cantaloupe	2,816	2,963	4,268	866	2,951	2,149	2,669 (4)
Cherry	714	834	731	621	165	103	528 (<1)
Grapes (wine)	618	298	324	322	257	68	314 (<1)
Melons	1,860	1,621	1,840	1,499	1,747	999	1,594 (2)
Nectarine	2,538	2,319	1,690	1,510	1,806	2,415	2,046 (3)
Peach	9,225	10,838	6,693	6,589	5,491	6,365	7,534 (11)
Plum	2,617	1,861	1,244	935	776	1,046	1,413 (2)
Prune	3,652	2,475	1,727	4,642	3,764	3,563	3,304 (5)
Tomatoes (for processing/canning)	1,036	1,554	285	808	797	3,554	1,339 (2)
Walnut (English, Persian)	2,130	1,620	2,650	999	317	1,353	1,512 (2)
Watermelons	153	210	789	300	367	127	324 (<1)
Other	3,212	1,537	1,770	2,317	1,040	2,794	2,112 (3)
Total	104,253	89,794	57,220	58,843	59,222	40,546	68313

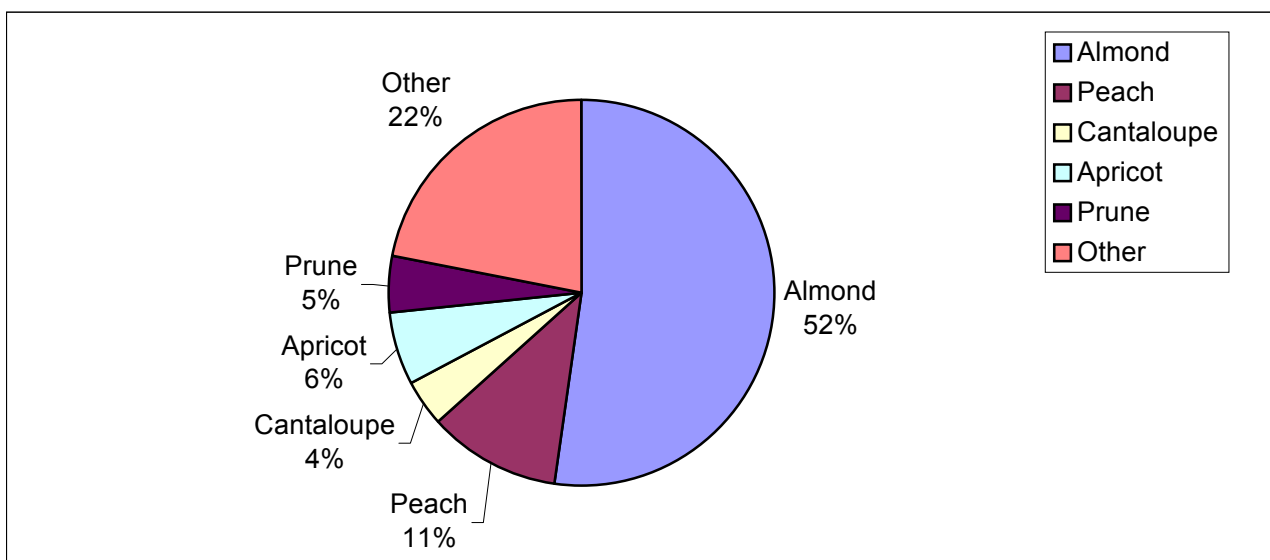


Figure 3.1 Average diazinon crop use in Merced and Stanislaus Counties, 1995-2000

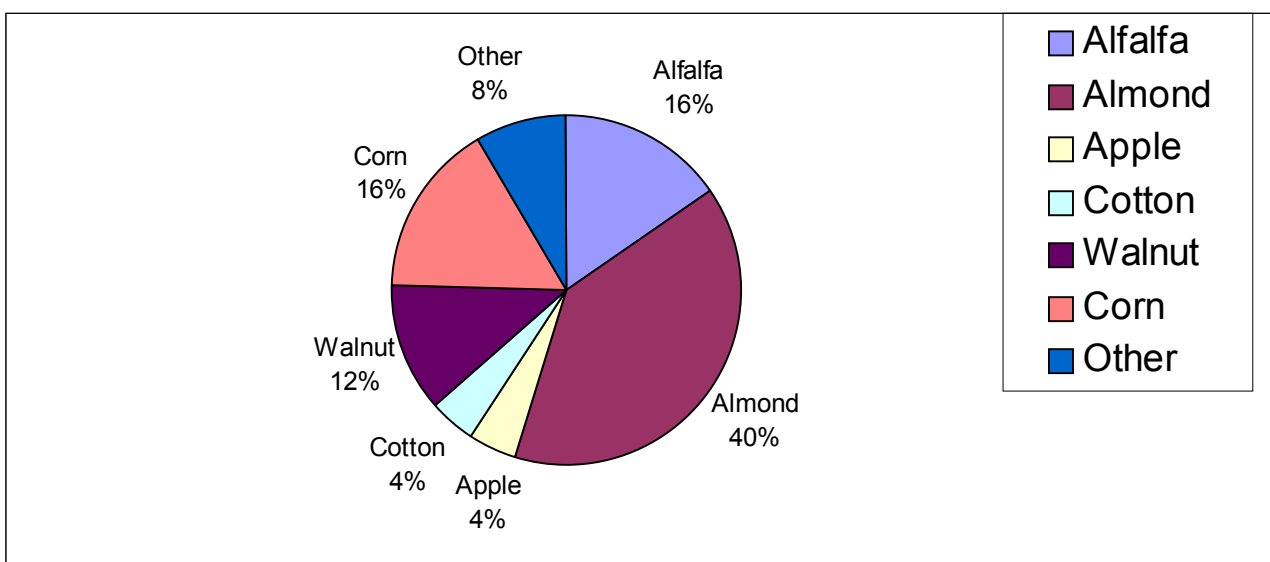


Figure 3.2 Average chlorpyrifos crop use in Merced and Stanislaus Counties, 1995-2000

Chlorpyrifos and diazinon were both primarily used on almonds. Almonds, apricots, peaches, dried plums and cantaloupes accounted for 78 percent of the total use of diazinon from 1995 through 2000 (Fig. 3.1). Almonds, alfalfa, corn, walnuts, cotton, and apples accounted for 92 percent of the total annual chlorpyrifos use from 1995 through 2000 (Fig 3.2). Chlorpyrifos and diazinon use on nut crops (almonds and walnuts) each accounted for an average of 52 percent of the amount of these compounds applied to all agricultural crops for 1995 through 2000. Diazinon use on stone fruit (peaches, apricots, and prunes) accounted for an average of 22 percent of diazinon applied to all agricultural crops. Use on alfalfa and corn accounted for an average of 16 percent each of the chlorpyrifos applied.

Seasonality of Application

There are two use seasons for OP pesticides: dormant season and irrigation season. The dormant season is defined as December through February. Irrigation season is defined as March through September. Monthly PUR records between 1995 and 2000 were assessed and the results are shown in Figures 3.3 and 3.4. Most diazinon was used on almonds during the dormant season. Most chlorpyrifos was used during the irrigation season; the greatest use was for almonds, followed by cotton, walnuts, and other crops. Slightly more chlorpyrifos was applied to alfalfa during the dormant season than during the irrigation season.

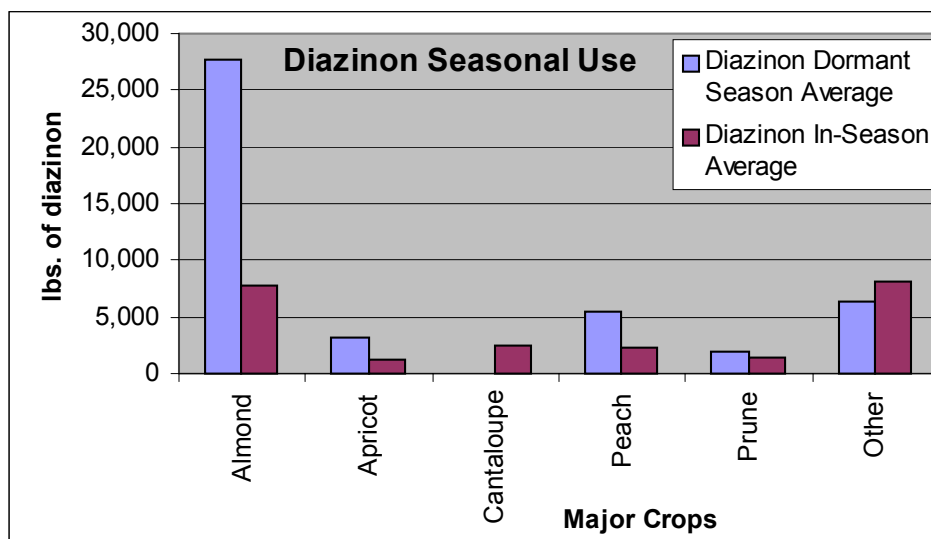


Figure 3.3 Diazinon Use

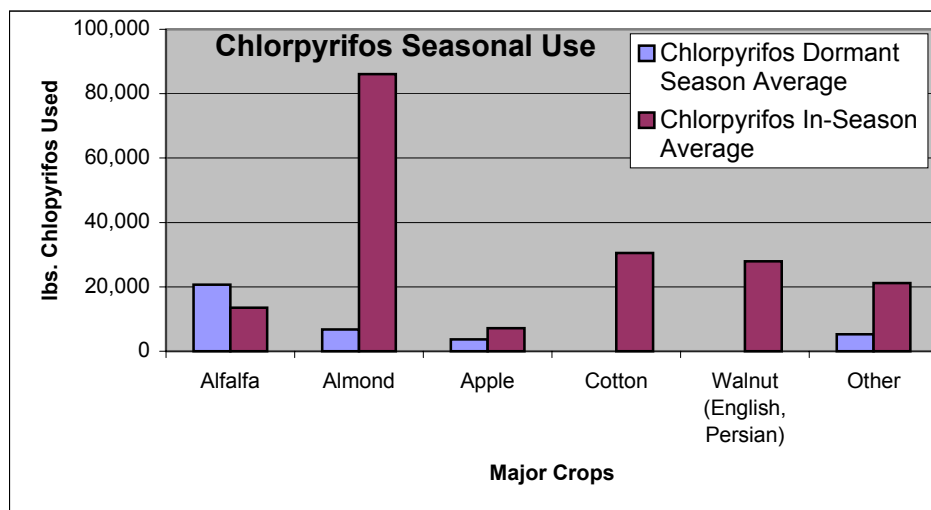


Figure 3.4 Chlorpyrifos Use

Current Management Practices: Dormant Oil with OP Pesticides

This current practice is generally very effective in controlling Peach Twig Borer, San Jose Scale, aphids and mites, and reduces or eliminates the need for in-season applications of other pesticides to control these pests. Any pest management strategies substituted for this current practice in order to reduce diazinon and chlorpyrifos concentrations in surface water would have to provide comparable control at a cost that still allows growers to make an acceptable profit. Any pest management strategies substituted for DO and OP pesticides would also have to minimize the potential for re-directed impacts. That is, they must not substitute one water quality problem for another.

Appropriate application methods, as discussed in section 3.1, can reduce the potential for off-site movement, however it is unlikely that these improved methods alone can reduce concentrations to acceptable levels. In addition, orchards vary greatly in their tendency to contribute to runoff because of slope, soil type, proximity to waterbodies, and other factors, making it very difficult to assess potential reductions due to changes in application practices. It is most likely that reductions in surface water concentrations of OP pesticides will be realized through changing pesticide use practices, rather than making relatively minor improvements to current practices.

3.2.2 Recent Changes in Approved Uses for Chlorpyrifos and Diazinon

In 2000 and 2001 the USEPA announced revised risk assessments and agreements with registrants for chlorpyrifos and diazinon. Provisions of the agreement involving chlorpyrifos are described in the revised risk assessment (USEPA, 2000b). Retail sales for residential uses of chlorpyrifos ended December 31, 2001. Changes in use for agricultural purposes apply to apples, tomatoes and grapes. For apples, only the production of chlorpyrifos products labeled for pre-bloom dormant application is allowed; post-bloom use is prohibited starting December 31, 2000. Production of chlorpyrifos products labeled for tomato use is prohibited effective August-September 2000, and the use is canceled as of December 2000. For grape use, the tolerance will be lowered. Currently, dormant applications are the only allowed use for grapes domestically. The lowered tolerance will allow for dormant applications, but not for foliar applications typically made on grapes that are imported to the United States.

For diazinon, the risk mitigation actions include the cancellation of products for indoor residential and non-residential uses, with all sales of products for indoor use ending December 2002 (USEPA, 2000a). In addition, outdoor non-agricultural registrations will be cancelled effective December 31, 2004. For agricultural uses, about 30% of the currently approved applications on agricultural crops are proposed to be cancelled. Use will be retained on over forty other agricultural crops. The USEPA Interim Reregistration Decision (IREDD) (July 31, 2002) has determined that agricultural use of diazinon, based on currently approved labeling, poses occupational and ecological risks. USEPA believes that these risks can likely be acceptably mitigated through changes to pesticide labeling and formulations. Products containing diazinon will be eligible for reregistration provided that 1) additional data that USEPA intends to require confirm the interim decision, 2) the risk mitigation measures outlined in the IREDD are adopted, and label amendments made to reflect these measures, and 3) cumulative risks considered for the organophosphates support a final reregistration eligibility decision. The proposed agricultural mitigation measures are:

- Cancellation of all granular registrations
- Deletion of aerial application for all uses

- Deletion of foliar application on all vegetable crops
- Application rate reduction
- Establishment of crop specific restricted entry intervals
- Cancellation of all seed treatment uses
- Require engineering controls for all uses
- Reduction in the number of applications of diazinon per growing season
- Application limitations and labeling on orchard crops
- Cancellation of uses on certain specific crops

USEPA is proposing to allow two years, with some exceptions, to put these mitigation measures in place. Cancellations will become effective after an announcement in the Federal Register and a final public comment period. USEPA is also in the process of developing more appropriate label statements for spray and dust drift control to ensure that public health and the environment are protected from unreasonable adverse effects (USEPA. August 2001).

3.2.3 Alternative Pest Management Practices

This section describes the following alternatives to current pest management practices-

- Reduce Application Rates of Diazinon and Chlorpyrifos
- Alternative Pest Management Practice: Early Season Applications of Dormant Oil and OP Pesticides
- Alternative Pest Management Practice: No Dormant Application or Dormant Oil Only and In-season Applications for Pests, as Needed
- Alternative Practice: Alternate Year Dormant Oil and OP with Yearly Oil Only Applications
- Alternative Pest Management Practice: Dormant Oil and Other OP, Pyrethroid or Carbamate Applications
- Dormant Oil and Spinosad for Peach Twig Borer
- Dormant Oil and Bt for Peach Twig Borer
- Pheromone Mating Disruption for Peach Twig Borer

A summary of costs for a selection of these alternatives is given in table 3.3.

Reduce Application Rates of Diazinon and Chlorpyrifos

UCIPM has published Pest Management guidelines for major pests of almonds and stonefruit (www.ipm.ucdavis.edu/PMG). The pesticide application rates UCIPM recommends are generally lower than the rates allowed by the pesticide labels, especially when insecticides are applied with dormant oil. It is not legal to apply pesticides at rates greater than those specified on the label. Table 3.4 depicts diazinon and chlorpyrifos label rates and compares them to the UCIPM recommended rates.

Table 3.3 Costs of Individual Pest Management Practices (per acre, per application)

PRACTICES	DO w/ OP	DO Only ⁽¹⁾	DO w/ Pyrethroid, Carbamate ⁽¹⁾	DO w/ Success ⁽¹⁾	DO w/ <i>Bt</i> at Bloom ^(1,5)	Pheromone Mating Disruption ⁽¹⁾	In-season Treatments, as Needed ⁽²⁾		
							PTB	Mites	Aphids
Total Cost	\$77-\$122	\$62	\$76-\$88	\$92	\$76	\$181	\$37-\$62	\$39-\$170	\$37-\$172
PCA ⁽³⁾									
Monitoring	\$30	\$30	\$30	\$30	\$30	\$30			
Application Cost ⁽⁴⁾	\$20	\$20	\$20	\$20	\$20	\$22	\$20	\$20	\$20
Supreme Oil (4g/a)	\$12	\$12		\$12	\$12		\$12	\$12	\$12
Supreme Oil (7g/a)			\$21			\$21			
Diazinon 50 (3-4 lb/a)	\$19								\$14
Lorsban 4E (2qt/a)	\$15								
Supracide25WP (8 lb/a)	\$60								
Success (60 oz/a)				\$30					
Dipel (1 lb/a)					\$14				
Imidan 70 (4.25 lb/a)							\$30		
Sevin 80S (1.25lb/a)			\$7				\$7	\$7	
Asana XL (5oz/a)			\$5				\$5		\$5
Pounce 3.2 (9-12 oz/a)			\$17				\$23		\$17
Ambush 25 (9-19 oz/a)			\$14				\$30		\$14
Vendex 50 (2lbs/a)								\$56	
Apollo SC (4oz/a)								\$58	
Omite 30 (7.5lbs/a)								\$45	
Agri-Mek 0.15 (20oz/a)								\$126	
Guthion 50 (4lbs/a)								\$45	\$45
Trilogy 90E (2g/a)									\$140
Check Mate						\$108			

Source: Zalom et al. (1999)

1) This practice may necessitate other in-season treatments for PTB, mites, aphids, and other pests, resulting in additional costs (see item #2, below)

2) Costs are per application; more than one application may be needed or more than one pest may need treatment

3) Costs are per acre per year regardless of treatment practice chosen

4) Cost is for equipment and labor, and per application. Assume grower applied with ground equipment.

5)Two applications are usually required.

Table 3.4 Comparison of Label Rates and UCIPM Recommended Rates for Diazinon and Chlorpyrifos

Crop	Diazinon Label Rate ¹ (lbs. a.i./acre)	Diazinon UCIPM Recommended Rate ² (lbs. a.i./acre)		Chlorpyrifos Label Rate ³ (pints/acre)	Chlorpyrifos UCIPM Recommended Rate ² (pints/acre)
		High ⁴	Low		
Almonds	3	2.0	1.0	4 - 6	3 - 5
Peaches	2	2.0	1.5	1.5 - 6	1.5 - 2.5
Plums	2	2.0	1.5	1.5 - 6	1.5 - 2.5

1) Label rate is for current Diazinon 50WP label

2) Source: UC Pest Management Guidelines www.ipm.ucdavis.edu/PMG/

3) Label rate is for Lorsban-4E

4) High rates recommended if high populations of San Jose Scale or Peach Twig Borer

Information collected for the Sacramento River Program of Implementation for Diazinon showed that growers typically apply diazinon at rates that exceed the UCIPM recommended rates for orchards with lower pest pressure. This may be indicative of one of two things: 1) growers that apply diazinon only do so when pest pressure is or has been historically high or 2) growers are not aware that application rates could be lowered and effective control maintained when pest pressure is or has been low. From available data it is not possible to determine what portion of the acreage treated at the higher rates experience higher pest pressure, but it seems unlikely that all do. Rather, growers probably apply diazinon at the maximum rates allowed by the label because the incremental cost of additional pesticide is very small compared to the rest of the cost of the application, the cost of additional pesticide applications or the risk of yield loss if pest infestations become serious later in the year.

Applying diazinon and chlorpyrifos at the lower rates recommended by UCIPM could result in substantial decreases in diazinon and chlorpyrifos concentrations in surface water, if rates could be reduced on sufficient acreage. The lower UCIPM diazinon rate for almonds is one-half that of the higher rate; for peaches and plums the lower rate is 25% less. The lower UCIPM chlorpyrifos rates for almonds and peaches are one-quarter that of the higher rate. Almonds seem to represent the most promising opportunity for reducing rates, given the larger disparity between the higher and lower recommended rates, and the generally lower pest pressure they experience. In addition, almond acreage accounts for approximately one-half of the total acreage of the major crops treated with dormant sprays, so a reduction in diazinon and chlorpyrifos rates applied to almonds could have a significant effect, particularly for orchards located close to, or draining directly to, waterbodies.

In addition to the UCIPM recommendations for lower application rates, improvements in the precision of sprayers to apply pesticides are being developed. Some of these improvements are now commercially available, while others are still in the research phase. Microencapsulated

formulations of diazinon may have application to dormant spray use in the future. The application of these formulations as well as improved sprayer and nozzle design, improved targeting of the crop, ultrasonic sensing, video sensing and GPS/GIS control all have potential to reduce the application rate, while improving the effectiveness of the pesticide application.

Early Season Applications of Dormant Oil and OP Pesticides

Dormant oil and OP pesticides are usually applied from late December through March, but most applications are made mid-January through February. By mid to late January orchards in the San Joaquin Valley have usually already received several inches of rain and the soils are saturated, which makes runoff more likely to occur than if the soils were dry.

UC IPM researchers (Zalom, pers comm) are investigating the pest management efficacy of oil and OP pesticide applications made early to mid-December. Based on one year of data, scale and aphid control appears to be as good or possibly better than with applications made later in the winter. Peach Twig Borer control appears to be slightly less effective but still acceptable.

Dormant oil can, however, be phytotoxic to moisture-stressed trees, and orchards are usually not irrigated after harvest. A solution to this would be to irrigate once after harvest in the fall, which would adequately hydrate trees but leave the upper soil horizon dry by December (unless rain had fallen). OP pesticides would then remain on the tree or soil surface for a longer time before the heavy winter rains, and could be partially broken down by photolysis and microbial processes before being washed off the tree or soil surface and soaking into dry ground. This technique would be likely to reduce the amount of diazinon entering surface water because of the partial physicochemical breakdown, and also because infiltration would be increased if soils were still dry.

The use of dormant oil and OP pesticides costs approximately \$80 per acre. This includes monitoring, the cost of the grower's application, and the cost of dormant oil and pesticide. Early applications of dormant oil and OP pesticide would cost the same as later applications. However, the extra irrigation applied in the fall to prevent phytotoxicity could require additional expenditures for irrigators' labor, electricity for pumping, and for the water itself. It would take time to inform growers about this option, and for growers to change their practices. It is likely that growers would want to wait for additional data. So far, only one year of data (winter 2000-2001) is available; and, although results have been favorable, future data may contradict these results.

No Dormant Application or Dormant Oil Only and In-season Applications for Pests, as Needed

In some orchards it would be possible to use dormant oil without an additional pesticide. Orchards would then be monitored during the growing season, and pesticides would be applied in-season as needed. This alternative is particularly applicable for almonds, and in orchards with low pest pressure from Peach Twig Borer and scale. For plums and prunes, and in orchards where aphids have historically been a problem, this alternative may not be as useful because the additional pesticide is needed to control aphids.

An overall reduction in the use of OP pesticides seems likely to result in a reduction in OP concentrations in surface water, although if orchards that drain to surface waters continue to use

OPs while orchards without runoff are the ones that reduce their use of OPs, then an overall reduction in use isn't likely to result in a reduction in surface water concentrations.

It would be difficult for a grower to predict ahead of time (i.e. during the winter dormant season) which practices will be necessary, so there is some risk involved in this practice. The efficacy and cost of dormant oil and OP pesticides are generally known, whereas the need to control other pests does not become apparent until the growing season, when it is too late to apply dormant controls. Some in-season insecticides, such as carbaryl, esfenvalerate, and permethrin, can kill beneficial insects and mites that control crop-damaging mites, making additional pesticide applications necessary. Orchard history and the grower's tolerance for risk are two important factors in considering this practice.

The cost of this option clearly depends on the kind and number of in-season applications necessary. No applications of any type would, of course, cost the least, but very few orchards would remain productive for more than a few years without any type of dormant or in-season treatments. If only dormant oil is applied during the winter, and no in-season applications are necessary, then per-acre cost would be about \$62, which includes monitoring, application costs, and the cost of the oil. If in-season applications of insecticides are necessary then cost vary depending on the pest problem. Some in-season insecticides, such as carbaryl, esfenvalerate, and permethrin, can kill beneficial insects and mites that control crop-damaging mites, making additional pesticide applications necessary.

This option can be implemented during any dormant season, and the decision to use this option can change from year to year, depending on pest pressure, crop values, and other factors, which provides convenient flexibility for growers.

Alternate Year Dormant Oil and OP with Yearly Oil Only Applications

Alternate year applications of dormant OP pesticides should, in theory, reduce potential environmental risks by one-half, assuming a mechanism were developed to restrict applications in a given year to half of the orchards on which a dormant spray might be applied. In addition, as discussed above, orchards vary in their potential contribution to OP concentrations in surface water, depending on their proximity to water, slope, soil type, and other factors. To use this option most effectively, the runoff potential would be identified for each orchard and applications would be allocated orchard by orchard, based on drainage areas.

Cost of this option would be approximately \$80 per acre in years when OP is applied and approximately \$62 per acre for dormant oil only, assuming monitoring were conducted each year. This option can be implemented in any dormant season, but would require two years to complete the alternate year cycle. It would likely require several years to determine its pest management implications, as pests can build up over multiple years. It would also likely require several years to determine its efficacy in reducing pesticide concentrations in surface water because rainfall and runoff conditions vary from year to year and largely determine pesticide concentrations in surface water.

Dormant Oil and Other OP, Pyrethroid or Carbamate Applications

Pyrethroids and carbamates are potential direct replacements for OP pesticides when used as dormant sprays, and substituting pyrethroids or carbamates for OP pesticides would reduce OP

runoff. Reduced adverse impacts associated with decreased uses of diazinon and chlorpyrifos may, however, be offset by adverse impacts associated with these other pesticides.

Pyrethroids are insoluble, and readily attach to soil particles. Therefore, pyrethroids are likely to stick to soil particles; they are therefore less likely to move offsite dissolved in runoff. Pyrethroids, however, could be carried offsite adsorbed to soil particles, and would then accumulate in stream sediments, from which they could be released to the water column. Pyrethroids are highly toxic to fish, and are difficult to monitor in surface water because of their tendency to attach to surfaces and because current detection limits are higher than concentrations at which pyrethroids are toxic to aquatic life. In addition, some of the pyrethroids used on orchards, such as esfenvalerate, have a high potential to bioaccumulate and bioconcentrate in aquatic organisms. (Werner et al., in press). When substituting pyrethroids for OP pesticides, additional applications may be needed in-season to control mites on almonds and peaches. Pest resistance to pyrethroids occurs more rapidly than OP resistance, necessitating a change to other pesticides within a few years.

Carbofuran is also toxic to aquatic organisms, and the Colusa Basin Drain has been listed on California's Clean Water Act Section 303(d) List of Impaired Waterbodies because of carbofuran concentrations (Regional Water Quality Control Board Central Valley Region, 2001). Carbofuran is highly toxic to bees, and applications must be timed carefully to avoid killing pollinators that are overwintering in orchards, or brought in for spring pollination.

Dormant oil and pyrethroid costs range from \$76 to \$88 per acre, including monitoring, but not including the costs of additional applications to control mites, if necessary. Like the Alternate Year Dormant Oil and OP with Yearly Oil Only Applications described above, this alternative would also likely require several years to determine its efficacy in reducing pesticide concentrations in surface water. Because rainfall and runoff conditions vary from year to year and largely determine pesticide concentrations in surface water, several years of evaluation would be required.

Dormant Oil and Spinosad for Peach Twig Borer (PTB)

Spinosad can replace OP pesticides when used as a dormant application to control PTB. Spinosad poses no known risk to surface water quality, however it does not control aphids or scale, and in-season applications of other pesticides may be necessary to control these pests, which may affect environmental and human health, as previously discussed. Dormant oil and spinosad cost approximately \$90 per acre.

Dormant Oil and *Bacillus thuringiensis* (Bt) for PTB

Concentrations of OP pesticides will be reduced in surface water if *Bacillus thuringiensis* (Bt) is used as a bloom-time spray for PTB, replacing dormant season applications of OP pesticides. However, Bt does not control scale or aphids, and use of Bt may result in a need for in-season applications of other OPs, pyrethroids, or other pesticides. Dormant oil and Bt cost approximately \$76 per acre for one application, however two applications are generally used, for a total cost of approximately \$122 per acre. This does not include the cost of in-season applications.

Pheromone Mating Disruption for PTB

When used properly, pheromone mating disruption for PTB can eliminate the need for OP pesticides or other pesticides added to dormant oil, with no impacts to water quality. However, it is most effective in relatively large orchards with low PTB populations, and it controls PTB only. Additional in-season pesticide applications may be necessary to control scale and aphids, with the considerations discussed above.

The cost of pheromone mating disruption is approximately \$180 per acre. This does not include the cost of additional in-season applications for other pests, as needed. Pheromone mating disruption can be implemented in any year during the spring season.

3.3 Vegetation Management Practices

In some orchards, pest management and environmental protection needs will be adequately met by using one or more of the pest management practices described above that do not pose a threat to water quality. In other orchards the use of diazinon and chlorpyrifos, or other OPs, pyrethroids, or carbamates, will still be necessary because of pest pressure or economic considerations. In orchards where these pesticides continue to be applied, specific vegetation management practices can be used to reduce risks to water quality by preventing pesticides from moving offsite. The following vegetation management practices may be used to manage pesticide runoff from orchards. In addition to reducing offsite movement of pesticides, these management practices also provide additional environmental benefits such as reducing nutrient runoff and soil erosion, and providing wildlife habitat, streambank protection and farm safety.

3.3.1 Conservation Buffers and Cover Crops

Conservation buffers are areas or strips of land maintained in permanent vegetation. Vegetation on the orchard floor, or along the orchard perimeter, can slow or stop the off-site movement of water and sediment, which allows the water to infiltrate and the sediment to be deposited on the field. These are important functions because pesticides are frequently dissolved in field water or adsorbed to sediment, and reducing the offsite movement of water and sediment keeps the pesticides on the field (NRCS, 2000). In addition, vegetation provides a large surface area to which pesticides can be adsorbed and degraded by chemical and biological processes (Ross et al., 1997).

The degree to which vegetation is likely to be effective in these processes depends upon the physicochemical properties of the pesticide, especially its soil adsorption coefficient (K_{oc}) and solubility. Site-specific characteristics, such as soil type, rainfall, slope, and distance from waterbodies, are also significant determinants of pesticide movement into surface water. Generally, the greater the K_{oc} of a compound, and the lower its solubility, the less likely the chemical is to move off site. K_{oc} is a more significant determinant of runoff potential than solubility. Some compounds, such as pyrethroids, have very high K_{oc} and very low solubility, and are much less likely to dissolve and be carried offsite into surface waters than the less adsorptive and more soluble diazinon. (Fawcett and Tierney, 2001) However, their high K_{oc} 's make pyrethroids likely to adsorb strongly to sediment particles, which can be washed off fields. When this sediment enters surface water, and remains on the substrate, pyrethroids are slowly released into the water column and potentially expose aquatic organisms to toxicity for an extended period.

Examples of conservation buffers include contour buffer strips, filter strips, hedgerows, riparian forest buffers, vegetated waterways, and constructed wetlands. To be effective in removing

soluble pesticides such as diazinon, buffers must slow runoff and increase infiltration. In this way, pesticides can be trapped and degraded in the soil and on the vegetation surfaces. Concentrated flow of runoff must be prevented, and shallow sheet flow encouraged, so that residence time in the buffer is sufficient for pesticide removal. Many studies have demonstrated trapping efficiencies of 50 percent or more with properly constructed and maintained buffers (NRCS. 2000).

The efficacy of buffers in reducing offsite movement specifically of diazinon and chlorpyrifos has not been well studied, but it can be inferred by examining results from studies on pesticides with similar physicochemical properties (Fawcett and Tierney, 2001). Table 3.5 summarizes studies examining trapping efficiencies of buffers and the physicochemical properties of commonly used pesticides.

Table 3.5 Trapping Efficiencies of Buffer Vegetation vs. Soil Adsorption Coefficient (Koc)

Pesticide	Koc	Reference for Buffer Study Data	Percent Pesticide Trapped	Buffer Width, Type
HIGHLY ADSORBED PESTICIDES				
Permethrin (P)	>39,000 ¹	NA	NA	NA
Trifluralin	8,000 ²	Rhode et al., 1980	86-96	GW
Chlorpyrifos (OP)	6,070 ²	Boyd et al., 1999	57-79	NA
Chlorpyrifos	6,070 ²	Cole et al., 1997	62-99	NA
Esfenvalerate (P)	5,273 ¹	NA	NA	NA
MODERATELY ADSORBED PESTICIDES				
Diflufenican	1,990 ²	Patty et al., 1997	62-99	NA
Diazinon (OP)	1,445¹	NA	NA	NA
Lindane	1,100 ²	Patty et al., 1997	72-100	NA
WEAKLY ADSORBED PESTICIDES				
Norflurazone	600 ²	Rankins et al., 1998	65	BS; G
Metolachlor	200 ²	Arora et al., 1996	16-100	NA
Cyanazine	190 ²	Arora et al., 1996	80-100	NA
Alachlor	170 ²	Lowrance et al., 1997	91	NA
Acetochlor	150 ²	Boyd et al., 1999	56-67	NA
Isoproturon	120 ²	Patty et al., 1997	99	NA
Atrazine	100 ²	Patty et al., 1997	44-100	G; 20-60'
Fluormeturon	100 ²	Rankins et al., 1998	60	NA
Metribuzin	60 ²	Webster and Shaw, 1996	50-76	BS; G; 13'
Carbofuran (C)	50 ¹	NA	NA	NA
2,4-D	20 ²	Asmussen et al., 1977	70	GW; 80'
Mecoprop	20 ²	Webster and Shaw, 1996	55-74	BS; G; 13'
Dicamba	2 ²	Cole et al., 1997	90-100	NA

GW = grassy waterway BS = buffer strip G = grass

NA = not available P = pyrethroid OP = organophosphate C = carbamate

1) Koc from USDA ARS Pesticide Properties Database (1995)

2) Koc from buffer strip study

Trapping efficiencies vary greatly between compounds, and between studies, but from these data it seems reasonable to assume that diazinon is likely to be trapped by properly managed buffers at efficiencies of 50 to 100 percent. Trapping efficiency for diazinon could be expected to be at the higher end of that range when solubility is also considered. Lindane is the pesticide investigated in buffer studies, which is most similar to diazinon in Koc and solubility, with a Koc of 1,100 and solubility of 7 ppm, compared to diazinon's Koc of 1,445 and solubility of 40 ppm (Fawcett and Tierney, 2001). Lindane was trapped at efficiencies of 72-100 percent in vegetated buffer studies (Patty, et al., 1997).

Studies on the efficacy of cover crops in reducing OP runoff have been conducted in California orchards, and the results support Fawcett and Tierney's (2001) conclusion that vegetation can be highly effective in trapping diazinon and other OP pesticides with similar physicochemical properties. In a study conducted by CDPR, mass runoff of the OP pesticides chlorpyrifos, diazinon, and methidathion from vegetated rows of a peach orchard was reduced by as much as 74 percent over bare soil with no vegetation (Ross et al., 1997). This study, conducted at a site with Yolo silty loam soil and slopes of 1-2 percent, indicated annual clover cover crops were the most efficient at reducing OP pesticide runoff mass when compared to oat cover crop and no cover crop. Insecticide runoff from vegetated rows was significantly lower than from non-vegetated rows. Chemical analysis of filtered versus unfiltered runoff water indicated that 10, 44 and 59 percent of the chlorpyrifos, diazinon and methidathion, respectively, that moved off the field was in the dissolved phase. The reduction in pesticide runoff is likely due to an increase in infiltration and decrease in runoff volume, adsorption to plant surfaces, and shorter pesticide persistence on vegetation than on bare soil.

Types of Conservation Buffers

The primary categories of buffers are:

- water buffers within fields,
- edge-of-field buffers and
- constructed wetlands.

Several types of buffers can be used in combination to further reduce the rate of runoff, and increase infiltration. Specific types of buffers within these categories are described in the following sections. Much additional information on conservation buffers is available from NRCS at <http://www.nrcs.usda.gov/feature/buffers> and from your NRCS Field Office.

Water Buffers within Fields

Water buffers within fields include vegetated waterways, contour buffer strips, and vegetative barriers. A vegetated waterway (Figure 3.5) is a shallow, wide channel that is graded to transport runoff water at a non-erosive velocity off the field to a stable outlet. Vegetated waterways are most effective in trapping sediment and dissolved chemicals when designed to spread concentrated water flow from fields over vegetated filters adjacent to streams. Contour buffer strips (Figure 3.6) are strips of perennial vegetation alternated with wider cultivated strips that are farmed on the contour of the land. Contour buffer strips are one of the most effective buffers to trap pesticides, particularly when runoff enters the buffer uniformly as sheetflow. Vegetative barriers function like contour buffer strips in that they are narrow, permanent strips of perennial vegetation that disperse concentrated flow of runoff, thus increasing sediment trapping and water infiltration.



Figure 3.5 Vegetated Waterway



Figure 3.6 Contour Buffer Strips

Edge of Field Buffers

Edge of field buffers include field borders, filter strips, vegetated setbacks and riparian forest buffers. Field borders are strips of perennial vegetation established on the edge of a field, that reduce pesticide runoff only when runoff flows over the strip. Even when no water flows over the strip, some water quality benefit may occur because spraying is physically separated from adjacent areas, reducing drift into riparian areas. Filter strips (Figure 3.7) are areas of grass or other permanent vegetation that are used to reduce contaminants in runoff; they are located between crop fields and waterbodies. Again, removal of pesticides is best achieved through proper installation and maintenance to encourage sheetflow and minimize concentrated flow across the strip. Vegetated setbacks are areas that are not treated with pesticides, where runoff enters streams. Seeding these areas with perennial grasses improves trapping pesticides that runoff from treated areas, compared to trapping with an untreated crop area. A Riparian Forest Buffer (Figure 3.8) is an area of trees and shrubs adjacent to a waterbody. Forest buffers are often combined with perennial grass buffers. Soil microbes in these buffers can degrade pesticides.



Figure 3.7 Filter Strips



Figure 3.8 Riparian Forest Buffer

Constructed Wetlands

Properly constructed riparian buffers and wetlands constructed at drainage tile outlets, or as part of a riparian buffer system, can effectively trap pesticides. They can also function to degrade pesticides through microbial activity.

Maintaining and Maximizing the Effectiveness of Buffers

All buffers can provide some protection of waterbodies if they are installed between pesticide treated fields and surface waters. To trap pesticides in runoff, buffers must be sited so that water runs over the buffer area at a rate slow enough to cause sediment fallout and pesticide infiltration. Without proper maintenance, concentrated flow is often prevalent by the time field runoff reaches streambanks. Natural berms and channelization may develop over time. These features become barriers to sheetflow off fields, and should be removed by leveling. Buffers adjacent to water should be shaped to encourage sheetflow, or various types of spreaders can be incorporated into the buffer design.

Buffers are most effective at trapping pesticides when located as close to treated fields as possible. Contour buffers strips are most effective because they are located within fields and are on the contour of the land, thus maximizing sheetflow across the buffer. Vegetated waterways intercept both sheet and concentrated flow from fields and can intercept pesticides close to the source. Wider strips encourage more sheet flow and infiltration as runoff enters the edges of waterways. Buffers are most effective on first and second-order streams at the top of watersheds, because the greatest volume of runoff enter stream systems from these streams. In watershed planning, likely sources of pesticides can be identified based on cropping patterns, and this information can be used to prioritize the placement of conservation buffers.

Costs of Conservation Buffers

The general cost of establishing buffers depends on the type and mixture of vegetation planted. Many of the plants used for buffers are the same as those used for cover crops, and cost estimates range from \$18 per acre for orchardgrass to \$81 per acre for Sheeps fescue. Depending on the site, a full border around an orchard may not be necessary for mitigating impacts to surface water. Filter strips could be planted at low ends of fields or other critical zones only. Some cover crop benefits, such as nitrogen production and soil improvement, can reduce costs for inputs such as fertilizers and soil amendments, offsetting the cost of planting and maintaining a cover crop.

One-half acre of hedgerow buffer that includes native grass and shrubs costs about \$2000 to establish and about \$1000 for periodic maintenance (Yolo County Resource Conservation District, 1999). Maintenance intervals would vary, but include some annual activities such as weed control. Maintenance costs would likely decrease over time. None of these costs includes potential losses from land taken out of production.

The timeframe to implement functional buffers depends on the vegetation used. Annual grasses and forbs become established within one growing season, but shrubs and trees require several seasons to be fully functional. Most buffers will provide some benefit the first year and benefits will increase for several years after that. Buffers require maintenance to preserve their function over many years. Technical assistance in designing and installing conservation buffers is available from local NRCS and Resource Conservation District Field Offices. Funding is available through the Environmental Quality Incentives Program (EQIP). The 2002 Farm Bill provided a large increase to previous EQIP funding levels, and California has been designated to receive \$7.7 million this fiscal year (2002-2003).

3.3.2 Reduce Herbicide-treated Berm Area

Many orchard trees are planted on a berm -- an area of bare soil three or four feet wide and raised six or eight inches off the orchard floor. The berm is kept free of vegetation with herbicides. This bare area is susceptible to sediment and diazinon and chlorpyrifos runoff because no vegetation is present to increase infiltration, trap pesticides, and reduce erosion. Reducing the size of this bare berm area would reduce diazinon and chlorpyrifos runoff correspondingly, and would reduce herbicide costs by as much as \$48 per acre. By reducing the berm to a 4 x 4-foot area around trunks herbicide costs would be reduced as much as \$36.00 per acre. The berm area treated with herbicides can be reduced or eliminated in a single growing season, but one to five years would be required to establish other vegetation in the area. The efficacy of reducing the bare herbicide zone are similar to those benefits described for cover crops, including runoff reduction through increased soil infiltration and decreased sediment runoff and sorption and biodegradation on vegetation and organic debris.

Orchard growers could reduce herbicide costs by either reducing or eliminating the herbicide-sprayed strip under fruit or nut trees. The berm area treated with herbicides can be reduced or eliminated in a single growing season, but one to five years would be required to establish other vegetation. Approximate cost savings are as follows:

No herbicides used: \$48.00 per acre

One less herbicide application: \$12.00 per acre

Herbicide treatment of 4-foot by 4-foot area around trunks: \$36.00 per acre

3.4 Field Crop Practices - Alfalfa

Alfalfa is a perennial crop and is one of the leading commodities in the Central Valley Region. In 1998, it was grown on one million acres of land in California (CDFA, 2001). In the Central Valley, it is harvested about seven to eight times a year, and stands generally last from four to five years (Long *et al.*, draft). The consistent major economic insect pests to alfalfa, depending on region, are the alfalfa weevil and the Egyptian alfalfa weevil. In the San Joaquin Valley, the major insect pest is the Egyptian alfalfa weevil. A resistant cultivar has yet to be developed. Retaining beneficial insects in a field can be successful at controlling aphids and summer worms, but is generally not as helpful in controlling Egyptian alfalfa weevil.

The organophosphorus compounds, chlorpyrifos, phosmet, malathion and dimethoate are applied to control the Egyptian alfalfa weevil. Carbofuran and pyrethroids are also applied. Early spring sprays, usually applied in February, March or sometimes early April, are conducted to control this pest. If pesticide application is necessary, thresholds and sampling outlined in UC IPM Guidelines are available and should be used. Chlorpyrifos is rated as having a relatively high toxicity to general predators and parasites of alfalfa pests and larval and adult honeybees. If chlorpyrifos is to be used, care should be taken to avoid spraying of weak areas of alfalfa fields since this would result in more material being deposited on the ground, thereby increasing the potential for movement offsite. While pyrethroids are another alternative for some pests and may potentially have less impact on water quality due to their low water solubility, they may cause a reduction in beneficial insect populations, that could result in aphid outbreaks. Pyrethroids are also highly toxic to fish, so that extreme caution should be used when spraying near waterways, or this use should be avoided.

A study by Long *et al.* (draft) suggests pyrethroids may be a viable option since field level studies showed that no toxicity was associated with tailwater samples collected from alfalfa fields. Additionally, no pyrethroid residues were detected in the samples at a detection limit of 50 ng/L. Alfalfa's deep root system helps reduce offsite movement of soil and its vigorous canopy prevents soil from being blown off. The Long *et al.* (draft) data on total suspended solids showed higher particulate levels in some source water samples compared to tailwater samples, suggesting that alfalfa may trap sediments.

3.5 Water Management

Simply reducing the volume of water that runs off agricultural fields may reduce pesticide runoff from these fields. This volume reduction can be achieved both through improved irrigation application practices that reduce the quantity of water applied and through drainage management. Though mostly applicable to the irrigation season, some agricultural drainage management practices may be successfully applied during the dormant spray season to control rainfall runoff. Sediments and pesticides conveyed by these sediments may also be reduced through application of compounds to irrigation and drainage water to strip water of sediment.

3.5.1 Irrigation Application Practices

Irrigation system selection is based on many factors including crop type, topography, water supply, soil type, system capabilities and cost. The irrigation system used can determine the potential for surface runoff and by inference, the amount of pesticide running off a field. The main types of irrigation systems to be discussed are subdivided into three categories: surface, sprinkler, and microirrigation. Surface irrigation methods result in the most runoff; many forms of surface irrigation, in fact, require runoff to achieve uniform distribution. Tailwater recovery

systems can, however, be put in place to reduce runoff. Little or no runoff is usually associated with sprinkler and microirrigation systems. In addition to these three methods of applying irrigation water, storage and regulating reservoirs are briefly discussed because of their potential to capture and store both irrigation water and rainfall runoff.

The use of improved irrigation methods such as sprinklers and drip irrigation will reduce the amount of water available to mobilize pesticides. Improved surface irrigation methods can achieve similar results. Aside from reducing offsite movements of pesticides, improved irrigation methods may also:

- Reduce the volume of water needed to wet the crop root zone
- Reduce erosion
- Increase the uniformity of applied water

Surface irrigation

A large group of irrigation methods falls under the classification of surface irrigation. This method relies on soil as the transportation medium while water is distributed over the surface of the field by gravity. The two basic categories of surface irrigation are “ponded” and “moving water.” Some runoff is required in “moving water” methods in order to ensure adequate infiltration at the lower end of the field, although tailwater return flow systems can be used in conjunction with surface irrigation to prevent runoff.

Typically, water enters the field at a high point or at the edge of a field and covers the field through overland flow. Soil type is important for this method since the depth infiltrated over time is determined by soil type. For sprinkler and microirrigation systems, on the other hand, the depth infiltrated is controlled by the application rate. The infiltration and advance characteristics of fields irrigated through surface irrigation changes over time. Because of this, pre-determining management recommendations is difficult or impossible to do. Irrigation control through field management is more important in surface irrigation compared to other mechanized systems where the need for intensive management is replaced by design and equipment (Burt *et al.*, 1999).

The main advantages associated with this type of irrigation are:

- Relatively simple equipment requirements
- Capital Cost: lowest initial capital investment.
- Labor Cost: low labor requirement if systems are flexible, have large flow rate supplies and tailwater return systems for sloping methods.
- Water Source: silty and dirty water can be used.
- Irrigation Efficiency and Uniformity: with the right combination of soil, land grading, management, variable flow rate supply and tailwater return systems, high efficiencies and uniformity can be achieved.

The main disadvantages associated with this type of irrigation are:

- Management Limitations: requires the most “art” in order to attain high application efficiencies and distribution uniformities.

- **Soil Differences:** within-field soil differences will greatly affect the distribution uniformity.
- **Irrigation Scheduling:** requires excellent historical records on each field.
- **Land Grading Limitations:** excellent land grading is required for some of the methods; this is difficult to achieve in small fields.

Sprinkler Irrigation

In sprinkler irrigation systems, water is delivered through pressurized pipe with nozzles, jets or perforated pipes. With sprinkler and microirrigation systems, the depth infiltrated is controlled by the application rate. However, soils with very low intake rates (less than 3 mm/hr) will require additional measures either to increase intake or to control runoff by providing uniform surface ponding. Types of sprinkler systems include:

- Hand Move Portable or Lateral Move Portable
- End-tow Lateral
- Side Roll/Wheel Line Systems
- Side Move Lateral
- Traveling Gun System
- Rotating Boom System
- Linear Move (Lateral Move) System
- Solid Set and Permanent System
- Undertree Orchard Sprinkler System
- Center Pivot System

Following are considerations for designing and using a sprinkler system:

- **Crops:** Most crops can be irrigated with sprinklers. Crop height is important to consider when selecting the type of system. Characteristics such as crops that may be prone to discoloration or rot should be taken into account. Sprinklers can sometimes be used for germination and establishing ground cover.
- **Soils:** Some type of sprinkler method can be used for irrigating most soils. For soils with intake rates of less than 3 mm/hr, it will be necessary to take measures either to increase intake or to control runoff by providing uniform surface ponding. Sprinklers can be used for pre-irrigation of soils with high intake rates
- **Topography:** Sprinklers can generally be used on any topography.
- **Water Supply:** Sprinklers require a constant rate water supply. If the water supply is available only on a rotational basis, the system would require excess capacity or on-farm storage
- **Salinity/Water Quality:** Less water is required to leach salt from the soil using sprinklers than with flooding methods, since water is moving through smaller soil pores in unsaturated conditions. Some filtration of surface water supplies is necessary to remove debris that could plug sprinkler orifices.
- **Climate:** Wind is an important consideration when selecting a system. For example, high-pressure guns and booms are designed for wide area coverage and would not be appropriate in high wind areas. LEPA and LESA sprinklers on center pivots and linear moves are not highly wind sensitive.

- **Efficiency:** Sprinkler efficiency will vary depending on the system selected, the design and its operation and maintenance. A sprinkler irrigation system that is well designed and properly operated will have little to no runoff.
- **Irrigation Scheduling:** Irrigation with hand moved and side roll sprinklers is used for a fixed duration of usually 12 or 24 hours. Scheduling involves waiting until the soil moisture depletion (SMD) matches the actual application depth, as opposed to drip/micro-irrigation where application depth and time is adjusted to match the SMD. Other types of sprinkler systems, such as center pivots and linear-moves, have a fixed application rate and variable speeds. The duration is variable and requires a minimum amount of time for cycle completion. Scheduling involves determining the hours/cycle or hours/week for the desired depth to be saturated. Schedulers need to balance the benefits depending on SMDs, since small SMDs tend to increase loss due to evaporation off wet foliage, while large SMDs reduce evaporation loss but increase the potential for runoff.
- **Management and Maintenance Requirements:** Some systems require less skill, but more labor and vice-versa. Hand move systems require the least skill and the most labor. Side roll and laterals require less labor but more skill. Portable solid sets require less labor and less skill. Center pivots, linear moves and LEPA systems require little labor but a good amount of skill. Permanent solid sets require the least amount of labor.

Microirrigation

Microirrigation systems allow for the distribution of water directly to plant root zones. It is used for efficient and uniform application of irrigation water and maintenance of soil moisture, and can also be used for the application of chemicals, i.e. chemigation. In this type of irrigation system, runoff is either reduced or eliminated and deep percolation is reduced. The need to over-irrigate to compensate for uneven application of water is eliminated.

The main classifications of microirrigation systems are surface or subsurface drip irrigation and microspray or microsprinkler systems. The surface and subsurface applicators range from drip tapes, trickle emitters, bubblers, sprays or spinners. The rates for each is generally less than 60 gal/hr for bubblers, less than 2 gal/hr for drip or trickle emitters and tapes and less than 45 gal/hr for spray or spinners. The water supply requires almost continuous flow rates during peak ET periods; which means implementation would be almost impossible unless ground water is used, and reservoirs can be used to buffer the supply. Drip can use saltier water than other irrigation methods because it can keep the soil moisture at high optimum water content, thereby reducing osmotic stress. Emitters, however, are very susceptible to clogging if water contains high solids. Dirty source waters have to be filtered extensively. Reservoirs serving as pre-filtration prior to regular filtration may be necessary to settle out sand and silt, or oxidize iron in well water.

This irrigation system can be used on row and orchard crops on almost all soils and topography. The soil type affects the number of emitters used per plant and affects the decision on whether to use microsprays/sprinklers versus drip. The net depth of application must be enough to replace the water used by the plant during the plant peak use period or critical growth stage without depleting the soil moisture in the root zone of the plant below the management allowed depletion (MAD). Because microirrigation raises the soil moisture level and decreases soil water storage capacity, the probability of runoff or deep percolation during storm events increases. This would not be a problem in areas with low to no rainfall during the irrigation season. In order to maintain a steady state salt balance, an adequate amount of water should be applied for leaching.

In general, distribution uniformity is dependent upon proper design, installation and maintenance. Distribution uniformity can be maintained with frequent irrigations (unlike surface irrigation) and without excessive non-beneficial evaporation losses (unlike sprinkler methods). In practice, however, it has been found that distribution uniformity tends to be low. Distribution uniformity may degrade quickly with time as a result of lateral flushing, insufficient filtration and/or chemical injection. Runoff is either reduced or eliminated and deep percolation is reduced. The need to over-irrigate to compensate for uneven application of water is eliminated.

Types of microirrigation systems include:

- Above Ground Orchard/Vineyard Drip
- Subsurface Orchard/Vineyard Drip,
- Orchard and Vineyard Microspray (and Microsprinkler),
- Row Crop Drip (Above Ground),
- Row Crop Drip (Subsurface)

Following are considerations for designing and using a microirrigation system:

- **Salinity/Water Quality:** Drip methods can use saltier water than other irrigation methods because the soil moisture can be kept at a high optimum water content, thereby reducing osmotic stress. Emitters, however, are very susceptible to clogging if the supply water contains solids, and dirty source water must be filtered. Reservoirs that serve as pre-filters may be necessary to settle out sand and silt, or to oxidize iron in well water.
- **Efficiency:** Runoff is either reduced or eliminated and deep percolation is reduced. The need to over-irrigate to compensate for uneven application of water is eliminated. In general, distribution uniformity is dependent upon proper design, installation and maintenance. It has been found that distribution uniformity tends in practice to be low. Compared to other methods, application efficiencies are higher. This may be due in part to ability to schedule period and duration of irrigations, and to the flow rate limitations of drip/micro pump designs.
- **Soils:** Micro irrigation can be used on almost all soils. Soil type affects the number of emitters used per plant and decision of micro versus drip irrigation. On trees with sandy soils, microsprays/sprinklers are more effective than drip because of the limited lateral movement with drip.
- **Water supply:** Requires almost continuous flow rates during peak evapotranspiration (ET) periods, which means implementation would be almost impossible unless ground water is used; reservoirs can be used to buffer the supply.
- **Climate:** Wind has minimal to no effect on water distribution.
- **Irrigation Scheduling:** Simple to schedule partly due to adjustable irrigation hours, since for the most part, amount infiltrated depends on hours of application, not soil intake characteristics. Runoff is usually not a problem, but may be a serious problem in areas with water penetration problems. Although the percentage of runoff is typically low in these areas (less than 5%, the localized runoff patterns within an orchard or vineyard cause serious problems with equipment movement.
- **Labor and Management Constraints:** Requires high learning curve when first installed, and leaves very little room for error.

Irrigation Water Storage and Regulating Reservoirs

An irrigation pit is a small storage reservoir constructed to regulate or store a supply of water for irrigation. Its purpose is to collect and store water until it can be used beneficially to satisfy crop irrigation requirements. Open pits excavated below ground surface can intercept or store surface water or unconfined groundwater for irrigation. The usable capacity of the pit must be sufficient to satisfy irrigation requirements throughout the growing season of the crop or crops being irrigated. Such pits may also be used to capture rainfall runoff during the dormant spray season. Irrigation regulating reservoirs are small storage reservoirs constructed to regulate or store a supply of water for irrigation. Reservoirs are created by impounding structures and pits excavated below the ground surface for short-period storage of either diverted surface water, water from pumped or flowing wells, or water from an irrigation delivery system. They may also be used to temporarily capture and store rainfall runoff during the dormant spray season.

3.5.2 Drainage System Management

Drainage management practices may be used to reduce the volume of water discharged from agricultural fields or to trap sediment and/or remove pollutants associated with drainage water or sediments. The practices discussed below are primarily applicable to the irrigation season, but may have some applicability to the dormant season as well.

Tailwater Recovery Systems and Water Recycling

Tailwater recovery refers to the practice of collecting, storing and transporting irrigation tailwater for reuse in an irrigation distribution system. These systems are suitable for use on sloping lands with surface irrigation systems, or for use in areas where there is recoverable irrigation runoff flow or where such flows can be expected under existing management practices.

Tailwater recovery systems require a sump or pit to store the collected tailwater until its redistribution, and return facilities such as pipelines and lined and unlined ditches. Sump sizes vary depending on the amount of water control desired. Small sumps with frequently cycling pumping plants may be sufficient if tailwater discharges into an irrigation regulation reservoir or into a pipeline where flow is controlled by a valve. Tailwater sumps large enough to provide the regulation needed to permit efficient water use are necessary for systems without facilities for regulating fluctuating flow. Sumps must be equipped with inlets designed to protect the side slopes and the collection facilities from erosion. A dike or ditch may be necessary to limit the entrance of surface water to the inlet, and the use of sediment traps also may be necessary.

Return facilities are necessary for conveyance of tailwater from the storage sump to the point of re-entry into the irrigation system. These facilities may consist of a pump and pipeline to return the water to the upper end of the field, or they may consist of a gravity-fed outlet connected to a ditch or pipeline to convey the water to a lower section of the farm irrigation system.

Berms

Raised berms at low ends of fields could hold water, increasing runoff retention and allowing for infiltration. This can result in trapping of sediment and adsorbed pesticides, and can reduce runoff of dissolved substances in fields with shallow slopes and sandy soil types. This practice is potentially applicable for both dormant and irrigation seasons. During the dormant season, berms may also be useful in areas with lower rainfall by reducing the amount discharged into surface water, or by providing an increased holding time. This would increase infiltration and/or increase time for pesticide breakdown prior to release of runoff to surface water.

Water and Sediment Control Basins

Water and sediment control basins are used to form a sediment trap and water detention basin. Their purpose is to trap sediment and pesticides absorbed to soil particles, reduce and manage runoff, intercept the flow of nutrients and pesticides, and improve water quality. The control basin can be an earth embankment or a combination ridge and channel. It is generally constructed across the slope and the minor watercourses to form a sediment trap and water detention basin. The basins serve to increase residence time by temporarily storing runoff on-site. The basin releases water slowly, through infiltration or a pipe outlet and tile line. The increased residence time allows suspended particles to settle out, resulting in better water quality.

The SRWP (June 2002) practices document notes that for many orchards in California, given the rainfall patterns, basins would not be viable for individual growers to implement because of the basin size that would be required to manage the volumes of water typically observed. It was suggested that this practice may be appropriate for community level implementation, where a given basin could serve a larger area and multiple farms. Sediment control basins, however, may have greater applicability in areas where rainfall is relatively low, such as the SJR Basin. (SRWP, 2002).

Vegetated Drainage Ditches

Drainage system management is an approach that seeks to increase the filtration capability of the drainage system. Increased filtration removes sediments, nutrients, and pesticides from the water. This filtration results in increased water quality downstream. One method of increasing filtration is through the use of vegetated drainage ditches.

Vegetated drainage ditches can be incorporated into a management program to help reduce offsite movement of pesticides with storm runoff. This involves using drainage systems that are a part of existing agricultural landscape features. The USDA Agricultural Research Service National Sedimentation Laboratory has initiated study in this area. Their interest arose from edge-of-field constructed wetland studies being performed for mitigation of atrazine, metolachlor and chlorpyrifos storm runoff, and the recognition that many in-place agricultural drainage ditches are similar in length and design to suggested constructed wetland buffers.

Moore *et al.* (2000) conducted a study on drainage ditches evaluating runoff of atrazine and lambda cyhalothrin. The ditch was approximately 4 meters wide at the top, 1.3 meters deep with a slope of .004. Water width within the ditch was about 1.5 meters. Simulated runoff discharge was 3.68 cubic meters per hour with a velocity less than 3 cm per second. A mixture of atrazine and lambda-cyhalothrin was amended directly into the ditch at concentrations of 28.9 mg/L and 0.46 mg/L, respectively. These concentrations were based on recommended application rates and worst-case storm runoff (5%). Sampling sites were located at 10 meters above the simulated runoff points of contact and 10, 20, 40, and 50 meters below the point of contact. Twenty-four hours following the simulated storm runoff, 59%, 29% and 12% of total measured atrazine was associated with plant material, sediment and water, respectively. Over the 28 day study duration, results from given cross sections of the ditch indicated that 42-77% of the atrazine was associated with plant material. For lambda-cyhalothrin, 97% of the total measured was associated with plant material and 3% with sediment 24 hours after the simulated runoff. For the study duration, 61-93% of the total measured lambda-cyhalothrin was associated with plant material. Regression analyses and previous storm assumptions indicated that aqueous concentrations of both pesticides could be mitigated to a no effects level (less than or equal to 20

ug/L for atrazine, and ≤ 0.02 ug/L for lambda-cyhalothrin) in a 50- meter length of agricultural drainage ditch.

3.5.3 Irrigation Water Additives

Chemicals may be added to irrigation water or agricultural drainage water to increase infiltration and/or reduce sediment loss. Polyacrylimide (PAM), for example, is a flocculating agent that can cause deposition in canals, laterals, head ditches, pipelines, furrows or other locations where it comes in contact with sediment-laden water. Bahr and Stieber (1996) examined the effects of PAM on nutrients, sediments and pesticides in irrigation water. They found that application reduced sediment loss, increased infiltration, and reduced pesticide concentration in tailwater. Pesticide analyses included chlorpyrifos. Deposition of sediment in drainage ditches that result from the use of PAM may require frequent cleaning to maintain normal functions of these facilities. Further study may be needed to evaluate any toxic or other adverse environmental impacts that may result from the use of PAM or other similar compounds. Additional research work relating to PAM can be found on the USDA/ARS website at: <http://wizard.arsusda.gov/acsl/ppdb.html>

3.6 Conclusions and Recommendations

Like pest management solutions, water quality solutions are site specific. Some orchards may contribute very little diazinon and chlorpyrifos to surface waters. Orchards that do not drain to surface waters and that are not located along watercourses may be able to use a wider range of pest management and agronomic practices without having an adverse impact on water quality. Orchards that eliminate or minimize the use of pesticides that threaten water quality may also pose a low risk to water quality.

Orchards that have runoff leaving the field, or that are located along watercourses, have a much greater need for careful management of diazinon, chlorpyrifos, pyrethroids, carbamates, and other pesticides. Preventing runoff from leaving the field through use of buffer strips, cover crops, or other methods is essential. Pesticide applications to these orchards should also not produce any spray drift that leaves the orchard. Growers should consider using only pesticides that pose a low risk to water quality on these orchards. For some alternatives, such as alternate year applications of diazinon and chlorpyrifos, applications may be allocated for specific orchards based on drainage areas.

It is important that efforts to reduce diazinon and chlorpyrifos concentrations in surface waters do not simply redirect impacts. For example, substituting pyrethroids, or other OP pesticides would simply result in more water quality problems. In addition, other pest management problems such as pest resistance could occur.

It is likely that substantive, long-term water quality improvements will require an overall reduction in the use of pyrethroid and OP pesticides, rather than just substituting one material for another. In addition, a number of precision pesticide application technologies are available and are in development. These technologies deliver better targeted pesticide application and can reduce the total amount of pesticide needed, with an increase in the effectiveness of the application. On-site runoff and erosion control mitigation measures such as buffer strips and cover crops can significantly reduce runoff if properly installed and maintained and are an essential component of water quality protection.

4 Surveillance and Monitoring

Porter-Cologne requires that the program of implementation describe the type of surveillance that will be required to determine compliance with the water quality objectives. The type of monitoring and surveillance required would depend on the implementation framework that is adopted. In general, responsibility for monitoring and surveillance will fall to three main groups: the Regional Board, the entity directly overseeing the implementation program (if it is not the Regional Board), and the parties responsible for adopting new management practices.

Monitoring and surveillance will include water quality and flow monitoring, evaluation of changes in pesticide use, and surveys of adoption of improved management practices. In addition to comments on the monitoring program described here, Regional Board staff would appreciate suggestions on additional goals or different approaches to meeting the goals described. The goals of the monitoring program will include:

- 1) determining compliance with established water quality objectives for diazinon and chlorpyrifos;
- 2) determining compliance with established waste load allocations and load allocations for diazinon and chlorpyrifos;
- 3) determining the degree of implementation of management practices to reduce off-site migration of diazinon and chlorpyrifos; and
- 4) determining the effectiveness of management practices and strategies to reduce off-site migration of diazinon and chlorpyrifos.

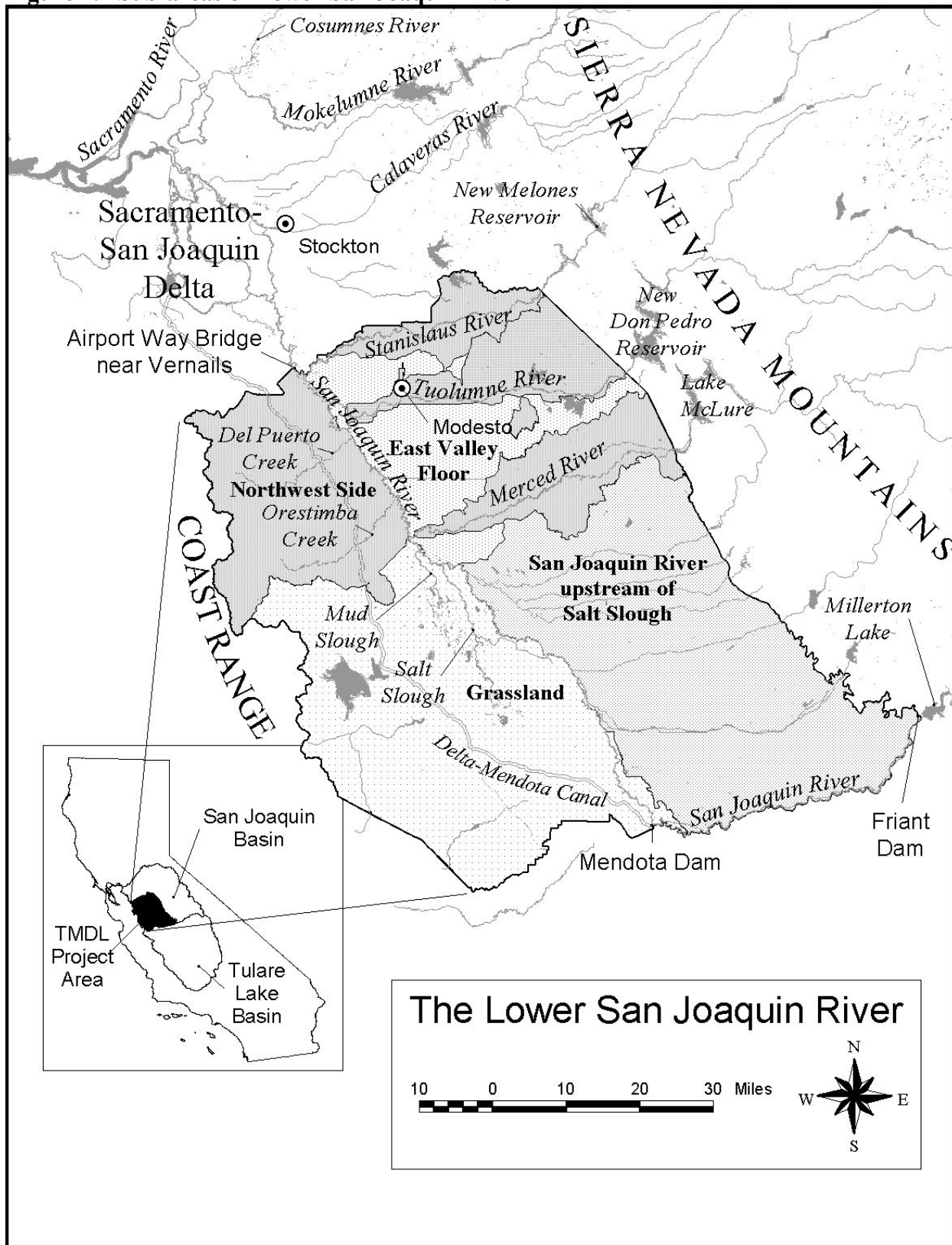
Of the four goals, the highest priority is to determine compliance with water quality objectives (Goal #1). If water quality objectives are not being met, then it is important to determine which areas are not meeting their allocations (Goal #2). If allocations are not being met, it is important to know whether the necessary management practices are being implemented to reduce off-site movement of diazinon and chlorpyrifos (Goal #3), and which practices are the most effective in reducing off-site movement of diazinon and chlorpyrifos (Goal #4).

4.1 Water Quality and Flow Monitoring

To provide the framework for a compliance monitoring program, pesticide sources were assessed using sub-areas within the basin. Figure 4-1 shows the sub-areas that were used for source analysis. Water quality monitoring will be needed to meet Goals 1, 2, and 4 and flow monitoring will be needed to meet Goals 2 and 4.

Numeric water quality objectives for diazinon and chlorpyrifos will be established in the San Joaquin River. To meet Goal #1, monitoring will need to occur at a sufficient number of sites within the San Joaquin River to assess compliance. The sites should be representative of a given river reach and sufficiently well mixed to provide a representative sample. The suggested sites are described in Table 4.1. Figure 4.2 shows the locations of the suggested sites.

Figure 4.1 Sub-areas of Lower San Joaquin River



Sampling should take place during the orchard dormant spray application (December to February) and irrigation seasons (March to August). The suggested frequency of monitoring is at least once a day during storm events (dormant spray application season), and at least once a day during a single storm event following the dormant spray application season. The definition of a “storm” event may be refined further, but will generally be triggered by at least 0.5 inches of rain in the Modesto area within a 24-hour time period, and will continue until diazinon and chlorpyrifos levels are below detection as determined by ELISA analysis²¹. The suggested frequency of monitoring is at least twice a week during irrigation season.

Table 4.1 Recommended Monitoring Sites for Meeting Monitoring Goal #1

Site	Sampling Point
San Joaquin River Near Vernalis	On the west bank of the San Joaquin River at the south side of the Airport Way bridge or from Airport Way bridge*
San Joaquin River at Maze Road	On the west bank of Highway 132 bridge or from Highway 132 bridge*
San Joaquin River at Patterson	North of Patterson bridge at the fishing access off of Poplar Avenue
San Joaquin River at Crows Landing	On the southeast side of Crows Landing bridge. Access via Gun Club gate
San Joaquin River upstream of Merced River	On the west bank of San Joaquin River approximately 30 yards south of Merced River. Access to the site is via Hills Ferry Road
Fremont Ford	At Fremont Ford on the west bank of the San Joaquin River at Highway 140
San Joaquin River at Lander Avenue	On the northwest corner of Lander Avenue (Highway 165) bridge over the San Joaquin River
Sack Dam	East of Highway 33 at Das Palos via Valeria Avenue
Mendota Pool	To be determined
* Location depends on flow and safety conditions	

To determine compliance with waste load and load allocations (Goal #2), flow and water quality monitoring will need to be conducted at sites that are representative of the manner in which allocations are ultimately assigned. Allocations may be based primarily on the subarea or watershed from which diazinon and chlorpyrifos runoff is occurring.

Monitoring for Allocation based on Subareas or Watersheds

Loads from the sub-watersheds within the San Joaquin River can be determined by establishing monitoring stations as near the mouth of the watershed as possible. In addition to monitoring diazinon and chlorpyrifos levels and flow at these sites, diazinon and chlorpyrifos levels should be measured at a site in the tributary upstream of the diazinon and chlorpyrifos use areas. This

²¹ ELISA analysis may be used as long as the analytical laboratory has an adequate quality assurance program that includes a calibration curve and quality control samples. The detection levels of ELISA must meet the water quality objectives and demonstrated by a method detection study. Ten percent of samples must be confirmed by another method using GC or GC/MS.

will allow identification of any diazinon and chlorpyrifos runoff that would be due primarily to aerial drift and atmospheric deposition.

To accurately estimate loading from subareas, flow diversions into and from the subarea must be monitored. At each diversion point, both flow and diazinon and chlorpyrifos levels must be monitored so that an accurate mass balance for the subarea can be performed.

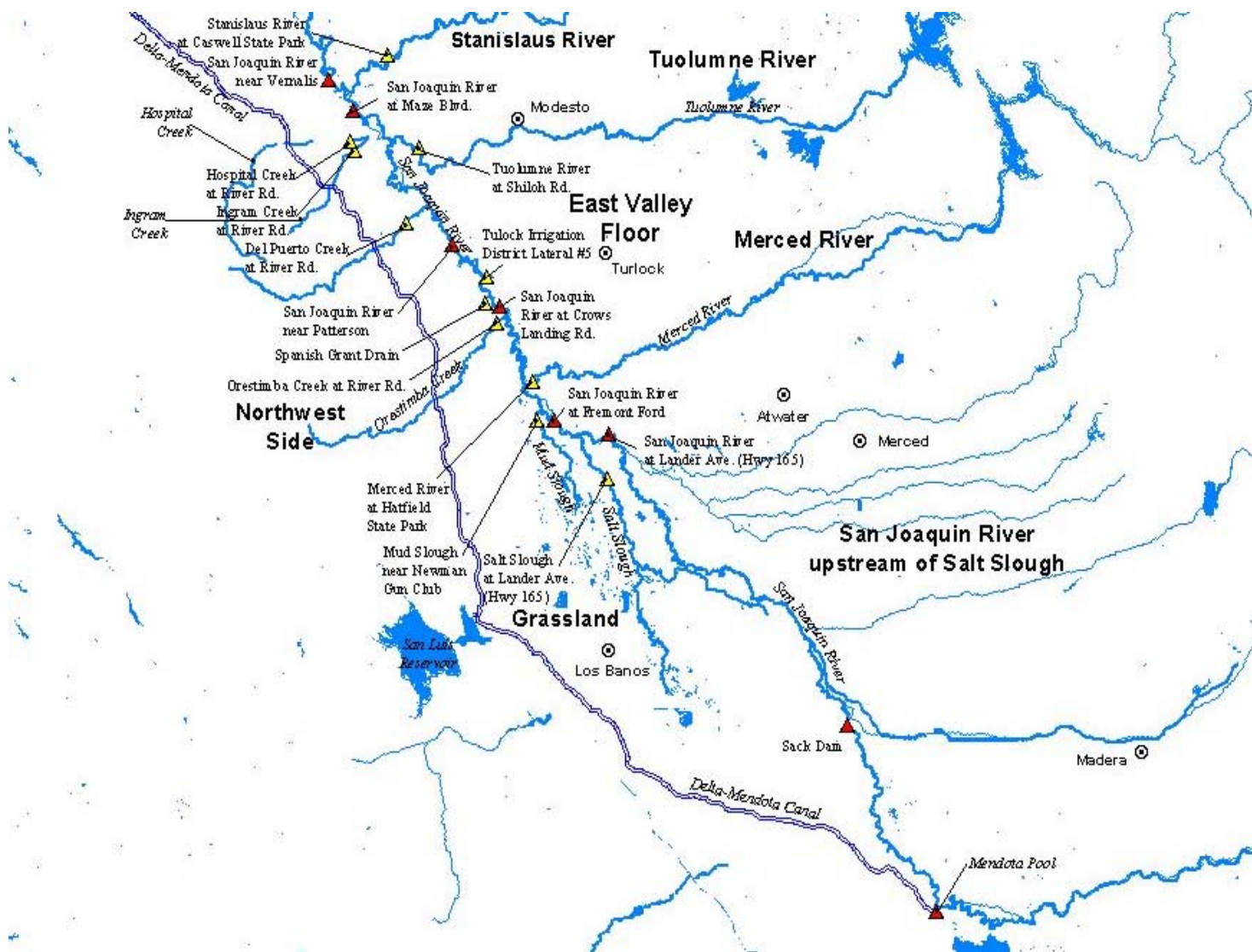


Figure 4.2 Geographic Area of Suggested Sites

Flow along the 130-mile reach of the SJR from Mendota Dam to Vernalis is highly dependent on tributary inflows and the managed hydrology of the SJR system. Flow gauging stations will need to be established at sub-watershed or tributary monitoring sites in the same fashion as for the river monitoring sites. Sampling frequency may need to be greater than once a day since sites in the sub-watersheds may respond more quickly and show greater variation within a day. The suggested sites are described in Table 4.2. Note that sites recommended for both Monitoring goal #1 and #2, such as the San Joaquin River at Lander Avenue, need be sampled only one time to meet goals #1 and #2. Figure 4.2 shows the location of the suggested sites.

Table 4.2 Suggested Monitoring Sites for Meeting Monitoring Goal #2 (Allocation based on watershed)

Watershed / Source Area	Monitoring Sites	Sampling Point
Stanislaus River	Stanislaus River	Stanislaus River at Caswell Park
		Stanislaus River upstream (to be determined)
Tuolumne River	Tuolumne River	On the left bank of Tuolumne River under the Shiloh Road bridge or from the Shiloh Road bridge
		Tuolumne River upstream (to be determined)
Merced River	Merced River	Off the old River Road bridge downstream of the Hatfield State Park. Access via Hills Ferry Road
		Merced River upstream (to be determined)
Northwest	Ingram Creek	On the east side of the River Road 200 feet downstream of the drain pipe
	Hospital Creek	Downstream of Hospital Creek crossing and River Road
	Del Puerto Creek	Off Loquat Road at the end of Cottonwood Road. The Creek is sampled upstream of the tailwater pipe entering the creek
	Orestimba Creek	Access via River Road prior to entering San Joaquin River. Sample is taking between the bridges.
	Spanish Grant Drain	On the River Road immediately east of the intersection of Marshall Road and River Road.
East Valley Floor	Turlock Irrigation District (TID) 5.	East bank of San Joaquin River 700 feet west of Carpenter Road. Access is via Carpenter Road.
Grassland	Salt Slough	Eastside of the Henry Miller where Salt Slough undercross the road. Access via Henry Miller Road
		Upstream of Salt Slough (to be determined)
	Mud Slough	Access through Kesterson Refuge from Highway 165. Sample off bridge.
		Upstream of Mud Slough (to be determined)
Upstream of Salt Slough	San Joaquin at Lander Ave	On the northwest corner of Lander Ave. bridge over the San Joaquin River.

Monitoring Effectiveness of Management Practices

To assess the effectiveness of specific management practices or strategies (Goal #4), field level evaluations will need to be conducted. The field evaluations should be able to quantify the amount of load reduction or reduction in off-site migration of diazinon and chlorpyrifos (in the case of practices to reduce drift) that could be expected with implementation of a new management practice or strategy.

4.2 Pesticide Use Evaluation

The most significant factors influencing the amount of diazinon and chlorpyrifos in the river are the timing of diazinon and chlorpyrifos application, the application rate, total amount of diazinon and chlorpyrifos applied, and point of application (these factors will be referred to collectively as diazinon and chlorpyrifos use patterns). All of this information can be found in or derived from the pesticide use reports submitted by applicators to the County Agricultural Commissioners and DPR. Evaluation of diazinon and chlorpyrifos use patterns can help in meeting Goals 1, 2, and 3 of the monitoring program.

Changes in diazinon and chlorpyrifos concentration and loads at specific monitoring sites in the rivers can be compared to diazinon and chlorpyrifos use patterns in land areas upstream of those monitoring sites. By comparing these changes and trends, the Regional Board can determine how changing diazinon and chlorpyrifos use patterns impact water quality (Goals #1 & #2).

Changing diazinon and chlorpyrifos use patterns can also provide an indicator of the degree of implementation of certain management practices (Goal #3). Practices focused on maintaining pest control with reduced application of diazinon and chlorpyrifos would result in lower application rates. Changes in timing of application (e.g. relative to storm events) could be evaluated based on the date of reported application. The number and quantity of applications of other pesticides can also be evaluated to determine whether growers are changing pest control strategies.

4.3 Monitoring of Adoption of Improved Management Practices and Technology

To meet Goal #3 (determine degree of implementation of management practices), information must be collected from growers on the types of practices being used and how those practices are being applied. The following factors should be considered in collecting this information: 1) minimize the paperwork burden on growers; 2) use existing reporting systems; 3) create a repository for the data that will allow for ease of data entry and analysis.

Data should be collected in the three broad areas described in Section 3: 1) pesticide application, mixing, and loading practices; 2) pest management practices; and 3) cultural practices. Experts in each of those broad fields should be consulted in designing the survey or reporting requirements to ensure relevant data is collected.

Special effort should be made on getting complete reporting from growers whose lands drain to the monitoring sites established for each crop/ county combination that will be identified later. This should allow the Regional board to relate the implementation of specific diazinon and chlorpyrifos runoff mitigation approaches to changes in diazinon and chlorpyrifos loading.

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